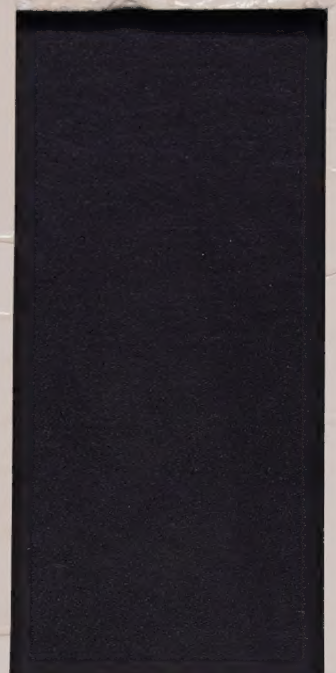
INSTRUCTION MANUAL

MODEL 2721
PCM SIGNAL CONDITIONER
REV A

Bit synch

EMR TELEMETRY DIVISION

BOX 3041 • SARASOTA, FLORIDA



12-1 8KB FWD
INPUT S&C
POLARITY NORM

OFFICIAL RECORDS STATION
FILE COPY
FACILITIES MAY 28 1985

INSTRUCTION MANUAL

MODEL 2721
PCM SIGNAL CONDITIONER
REV A

Bit synch

EMR TELEMETRY
BOX 3041 • SARASOTA, FLORIDA 33578

PRINTED JULY, 1968

© 1968 • EMR DIVISION OF WESTON INSTRUMENTS, INC., A SCHLUMBERGER COMPANY

PCM CODES Pg 4-3

NOTICE

IN THE EVENT THIS EQUIPMENT MUST BE RETURNED TO EMR FOR ANY REASON, SPECIAL CARE MUST BE EXERCISED IN PACKAGING FOR SHIPMENT. CARTON WITHIN A CARTON TYPE PACKING, WITH FOAM SUPPORT AND SEPARATORS IS RECOMMENDED TO PREVENT SHIPPING DAMAGE. SHOULD ANY INFORMATION BE REQUIRED REGARDING PACKAGING OF EMR EQUIPMENT, CONTACT EMR-TELEMETRY, SARASOTA, FLORIDA.

TABLE OF CONTENTS

SECTION		PAGE
1	GENERAL DESCRIPTION	1-1
	1.1 Introduction	1-1
	1.2 Functional Description	1-1
	1.3 Physical Description	1-2
2	SPECIFICATIONS	2-1
	2.1 General	2-1
	2.2 Electrical Specifications	2-1
	2.2.1 Inputs	2-1
	2.2.2 Outputs	2-3
	2.2.3 Synchronization	2-4
	2.2.4 Controls	2-5
	2.3 Mechanical Specifications	2-6
3	INSTALLATION AND OPERATION	3-1
	3.1 Installation	3-1
	3.2 Operation	3-6
	3.2.1 Front-Panel Controls, Indicators and Monitor Jacks	3-6
	3.2.2 Operating Procedures	3-6
	3.2.2.1 Local Operation	3-6
	3.2.2.2 Remote Operation	3-16
4	THEORY OF OPERATION	4-1
	4.1 General	4-1
	4.2 General Theory of Operation	4-1
	4.3 Detailed Theory of Operation	4-6
	4.3.1 Input Amplifier	4-6
	4.3.2 Split-Phase-to-NRZ Converter	4-9
	4.3.3 Bit-Rate Filter	4-12
	4.3.4 Bit-Rate/2 Filter	4-15
	4.3.5 Reset Integrator	4-18
	4.3.6 Phase Shifter	4-21
	4.3.7 Loop Amplifier/Filter	4-25
	4.3.8 Voltage-Controlled Oscillator	4-31
	4.3.9 Divider	4-34
	4.3.10 Split-Phase Clock Reset	4-37
	4.3.11 Loss Lock and Counter	4-40
	4.3.12 Positive Counter	4-43
	4.3.13 Negative Counter	4-46
	4.3.14 Bit Decision and Code Converter	4-49

TABLE OF CONTENTS (CONT'D.)

SECTION 4 (CONT'D)			PAGE
	4.3.15	Output Amplifier	4-54
	4.3.16	Control Card No. 1	4-58
	4.3.17	Control Card No. 2	4-63
	4.3.18	Control Card No. 3	4-67
	4.3.19	Control Card No. 4	4-67
	4.3.20	Power Supply and Regulator	4-74
	4.3.21	Assembly AIAI Display Card	4-78
	4.3.22	Integrated-Circuit Module Description	4-78
5	MAINTENANCE		5-1
	5.1	General	5-1
	5.2	Inspection	5-1
	5.3	Test Procedures	5-2
	5.3.1	Power Supply Assembly	5-2
	5.3.2	Functional Assembly Tests	5-3
	5.3.2.1	Input Amplifier	5-3
	5.3.2.2	Split-Phase-To-NRZ Converter	5-3
	5.3.2.3	Bit-Rate Filter	5-4
	5.3.2.4	Bit-Rate/2 Filter	5-4
	5.3.2.5	Reset Integrator	5-4
	5.3.2.6	Loop Resistor	5-4
	5.3.2.7	Voltage-Controlled Oscillator	5-5
	5.3.2.8	Loss of Lock and Counter	5-5
6	PARTS LIST		6-1
	6.1	General	6-1
	6.2	Provisioning Considerations	6-1
	6.3	Ordering Instructions	6-2

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1-1	Location of Major Subassemblies	1-3
1-2	Printed-Wiring-Board Locations, Card-File Assembly A2	1-5
3-1	Location of Rear-Panel Connectors	3-2
3-2	Remote Connector (A4J1) Pin Locations	3-4
3-3	Model 2721 Signal Conditioner, Front-Panel Controls, Indicators, and Monitor Jacks	3-7
3-4	Bit-Rate Selection--First Two Most-Significant Digits	3-13
3-5	Bit-Rate Selection, Third Most-Significant Digit and Multiplier	3-14
3-6	Input-Signal Polarity, Detection and Recorder Signal-Output Code Selection	3-14
3-7	Loop Width and Tracking Range Selection	3-15
3-8	Input-Signal Code Selection	3-16
3-9	Model 2721 Signal Conditioner Remote Programming Format	3-17
4-1	Model 2721 PCM Signal Conditioner, Block Diagram	4-2
4-2	Input Signals Timing Diagram and Glossary	4-3
4-3	Input Amplifier Card	4-7
4-4	Split Phase-To-NRZ Converter	4-10
4-5	Split-Phase-To-NRZ Converter Timing	4-12
4-6	Bit-Rate Filter	4-13
4-7	Typical Bit-Rate Filter, Input-Output Waveforms	4-15
4-8	Bit-Rate/2 Filter	4-16
4-9	Typical Bit-Rate/2 Filter, Input-Output Waveforms	4-18
4-10	Reset Integrator	4-19
4-11	Typical Reset Integrator, Input-Output Waveforms	4-21
4-12	Phase Shifter	4-22
4-13	Input Selection Phase Shifter	4-24
4-14	Phase Shifter, Typical Waveforms	4-25
4-15	Loop Resistor Card	4-26
4-16	Loop Capacitor Card	4-28
4-17	Loop Amplifier/Filter Timing Diagram	4-30
4-18	Voltage Controlled Oscillator (VCO) Card	4-32
4-19	Divider Card	4-35
4-20	Split-Phase Clock Reset Card	4-38
4-21	Loss-of-Lock Card	4-41
4-22	Positive Counter Card	4-44
4-23	Negative Counter Card	4-47
4-24	Bit Decision and Code Converter	4-50
4-25	Bit-Decision Circuit Waveforms	4-52
4-26	Clock Pulse Inhibit Waveforms	4-53
4-27	Example of Code Conversion Logic	4-55
4-28	Output Amplifier Card	4-56

LIST OF ILLUSTRATIONS

FIGURE		PAGE
4-29	Control Card No. 1	4-59
4-30	Control Card No. 1, Logic Diagram	4-61
4-31	Control Card No. 2	4-64
4-32	Control Card No. 2, Logic Diagram	4-66
4-33	Control Card No. 3	4-68
4-34	Control Card No. 3, Logic Diagram	4-70
4-35	Control Card No. 4	4-71
4-36	Control Card No. 4, Logic Diagram	4-73
4-37	Power Supply, Wiring Diagram	4-75
4-38	Regulator	4-76
4-39	Assembly A1A1, Display Card	4-79
4-40	High-Speed Differential Comparator Integrated Circuit (μA710)	4-80
4-41	Wide-Band DC Amplifier Integrated-Circuit Module (μA712)	4-81
4-42	DC Set/Reset Flip-Flop Integrated-Circuit Module (MC352G)	4-82
4-43	Bias Driver Integrated-Circuit Module (MC354G)	4-83
4-44	Three-Input OR/NOR Integrated-Circuit Module (MC356G)	4-84
4-45	JK Flip-Flop Integrated-Circuit Module (MC358G)	4-85
4-46	Dual NOR Integrated-Circuit Module (MC360G)	4-86
4-47	Level Translator (MC1512)	4-87

LIST OF TABLES

TABLE		PAGE
1-1	List of Major Subassemblies	1-2
1-2	List of Printed-Wiring Boards	1-4
3-1	Function of Rear-Panel Connectors	3-3
3-2	Remote Connector A4J1, Signal Identification	3-4
3-3	Function of Front-Panel Controls, Indicators and Test Jacks	3-8
5-1	Power Supply Voltage Limits	5-2
5-2	Wiring Schedule	5-2
6-1	Parts List	6-3

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual contains information describing the EMR Model 2721 PCM Signal Conditioner. Included in this information is a functional and physical description, specifications, installation and operation procedures, theory of operation, and replaceable parts lists.

The signal conditioner is a precision solid-state instrument designed for use with a PCM decommutator in a PCM data-acquisition or -checkout system. Components of the signal conditioner are contained in a single self-contained assembly requiring only a serial PCM signal input and primary AC power for local operation. When operated remotely, one instruction-transfer line input and 16 data line inputs from an external computer are required to program the signal conditioner.

1.2 FUNCTIONAL DESCRIPTION

The signal conditioner accepts a serial pulse-code-modulated (PCM) input from a receiver, magnetic tape recorder, or signal simulator; conditions the input PCM signal, and provides serial PCM data and bit-synchronized timing outputs suitable for processing by a PCM decommutator or recording by a magnetic tape recorder. Input-bit frequencies between 10 bits and one megabit may be accommodated through local or remote programming. The signal conditioner accepts any one of eight PCM input codes and generates a noise-free NRZC serial PCM output accompanied by four bit-rate pulse trains marking each bit period in the serial PCM data. An additional NRZC, NRZM, or SØC output is provided for tape recording. The eight PCM input codes selectable by local or remote programming are: NRZC, NRZM, NRZS, SØC, SØM, SØS, RZ, and bipolar at levels between 500 Mv and 30 volts peak-to-peak. The four bit-rate clock pulse outputs are at 0°, 90°, 180°, and 270° with respect to the NRZC serial PCM output data.

NRZC = NRZL SØ = BΦ

The programming format, including module and group addresses as well as the specific instructions, is under control of a computer or front-panel switches. Parameters controlled by the computer or front-panel switches are bit rate, input code, polarity, detector type, phase-locked-loop width, capture, and tracking range and output code.

An internal power supply operates from an AC power input of 115 or 120 volts RMS, 47 to 65 Hz, and generates all voltages necessary for the operation of the signal conditioner.

1.3 PHYSICAL DESCRIPTION

The signal conditioner is a self-contained unit, 22 inches in overall depth. This unit is 5-1/4 inches high and occupies 19 inches of panel width in the mounting equipment. Two versions of the signal conditioner are available: Model 2721-01-0 and Model 2721-01-1. These are described as follows:

a. Model 2721-01-0--Standard unit supplied without mounting slides.

b. Model 2721-01-1--Standard unit supplied with mounting slides.

The major subassemblies of the signal conditioner are designated with an A (assembly) prefix for identification purposes. The major subassemblies are illustrated in Figure 1-1 and described in Table 1-1. Printed-wiring-board locations in Card File Subassembly A2 are shown in Figure 1-2 and listed in Table 1-2.

Table 1-1. List of Major Subassemblies (See Figure 1-1)

REF. NO.	NAME	FUNCTION AND DESCRIPTION
A1	Front Subpanel Assembly	Provides mounting for front panel and all front-panel controls and displays.
A2	Card File Assembly	Provides mounting for printed-wiring boards and their associated connectors. (See Figure 1-2.)
A3	Power Supply Assembly	Provides mounting for all power-supply components.
A4	Rear Panel Assembly	Provides mounting of fuses, jacks, input/output connector, and blower.

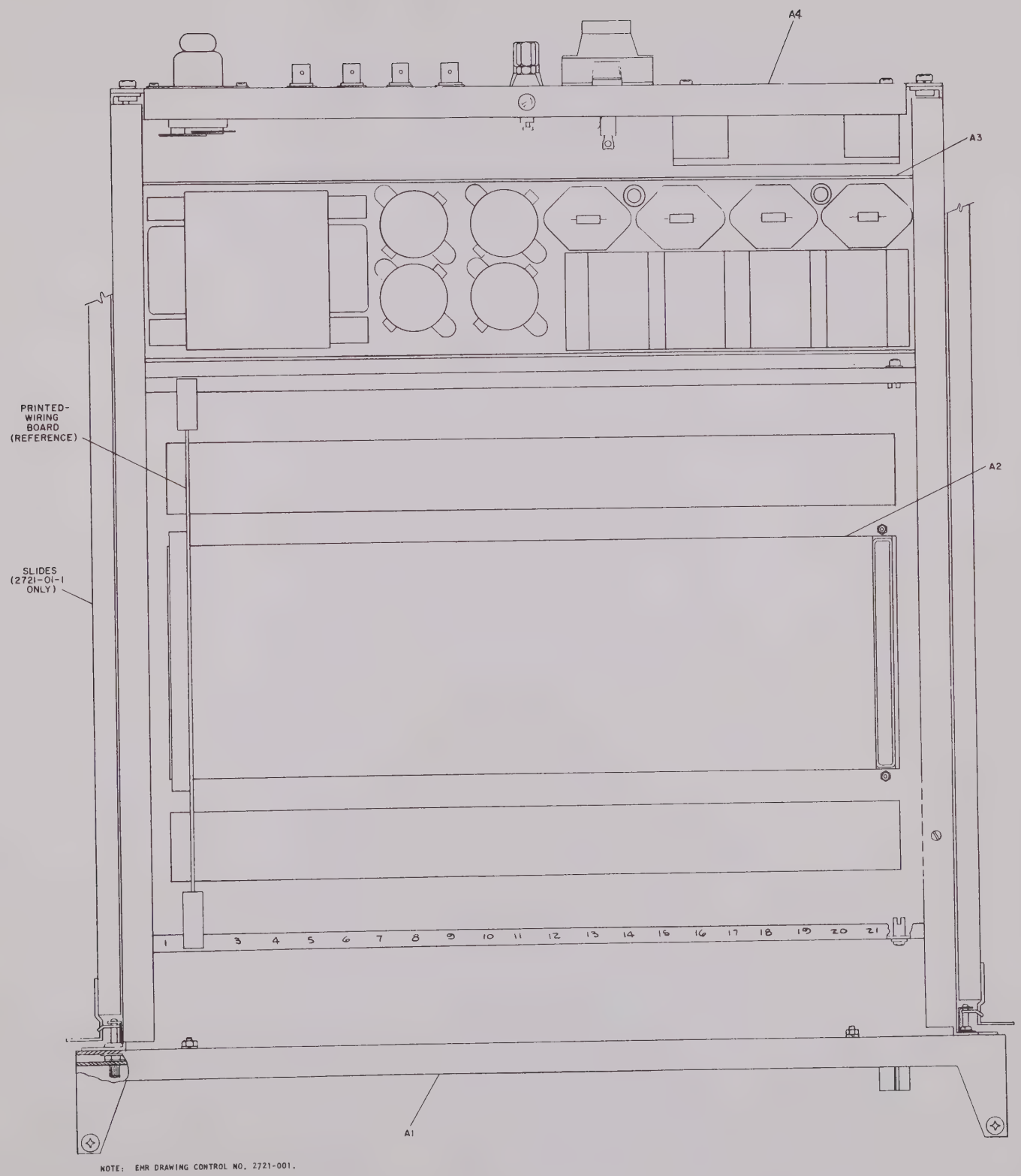
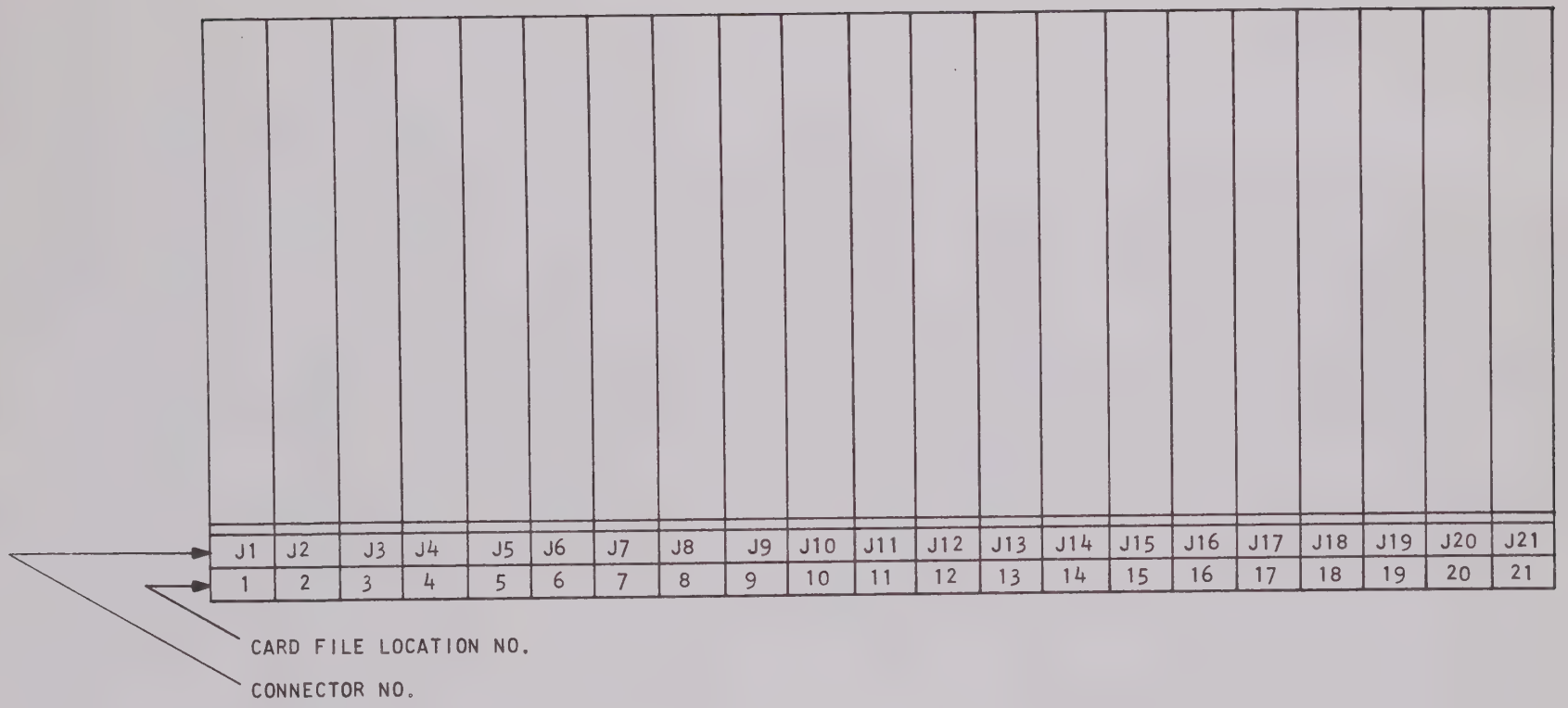


Figure 1-1. Location of Major Subassemblies (See Table 1-1)

Table 1-2. List of Printed-Wiring Boards (See Figure 1-2)

CARD NO.	ASSEMBLY NO.	PRINTED-WIRING-BOARD NAME
1	6485	Input Amplifier
2	6483	Split-Phase-to-NRZ Converter
3	6487	Bit-Rate Filter
4	6491	Reset Integrator
5	6489	Bit-Rate/2 Filter
6	6493	Phase Shifter
7	6495	Bit-Decision and Code Converter
8	6497	Negative Counter
9	6499	Positive Counter
10	13160	Loop Resistor
11	6503	Loop Capacitor
12	6505	Divider
13	13215	Voltage-Controlled Oscillator (VCO)
14	14925	Split-Phase Clock Reset
15	6511	Loss Lock and Counter
16	11413	Output Amplifier
17	11384	Control No. 1
18	11382	Control No. 2
19	11380	Control No. 3
20	11378	Control No. 4
21	13163	Regulator



NOTE:

1. EMR DRAWING CONTROL NO. 2721-002.

Figure 1-2. Printed-Wiring-Board Locations, Card-File Assembly A2
(See Table 1-2)

SECTION 2

SPECIFICATIONS

2.1 GENERAL

This section contains the electrical and mechanical specifications for the Model 2721 PCM Signal Conditioner. The electrical specifications are the minimum standards for the operational performance of the Model 2721.

2.2 ELECTRICAL SPECIFICATIONS

2.2.1 Inputs

a. Serial PCM Signal Input: Accepts NRZC, NRZM, NRZS, bipolar, 50% RZ, SØC, SØM, and SØS serial PCM data having the following specifications.

1. Input Level--Accepts a serial PCM input signal of any magnitude from 0.5 to 30 volts peak-to-peak. A front-panel meter indicates the input signal level. The two peak-to-peak input voltage ranges are as follows:

   (a) 0.5 to 10 volts.

   (b) 1.5 to 30 volts.

2. Input DC Offset--A DC offset of any magnitude up to ±100 volts in the input signal shall not degrade signal-conditioner operation.

3. Input AC Offset--Amplitude of up to 100% peak-to-peak signal level frequency of up to 0.1% of nominal bit rate; minimum transition density of 50%.

4. Input Polarity--Normal or inverted, as selected by front-panel switching or external programming.

5. Input Impedance--Equal to or greater than 500K ohms shunted by a maximum capacity of 150 Pf.

6. Input Configuration--Single ended, referenced to signal ground.

7. Input Bit-Rate Range--Accepts PCM data operating in the range of 10 to 1,000,000 BPS for all PCM input codes. The bit rate is selectable by means of front-panel switching or external programming.

8. PCM Signal Filtering--For optimum operation, either a constant-time delay filter or reset integrator can be used to extract the PCM signal from the noise. Since RZ signal frequency spectrum is twice as wide as that of the NRZ signal, separate filters are provided for RZ and NRZ signals. The reset integrator may be selected for filtering split-phase signals.

b. Remote Programming Inputs: The PCM signal conditioner receives one 16-bit instruction word and one input-strobe level having the following specifications.

1. 16-Bit Instruction Word--Instruction word is broken down as follows:

   (a) Module Address--Used for remote control only. Four-bit code, selectable by means of internal-jumper wires, allows addressing and programming from a remote source.

   (b) Group Address--Four-bit field specifies the signal-conditioner function to be programmed. (Only three bits are used in the Model 2721.)

   (c) Instruction--Eight-bit field specifies the required function parameter to be entered into the signal conditioner storage registers.

2. Input Strobe Level--When an input-request level from the signal conditioner is applied to the computer, the computer applies a logic ONE level to the signal conditioner to transfer the programmed instruction word into the signal conditioner storage registers.

3. Remote Programming Control Logic Levels--

   (a) Input Levels: Logic ZERO = 0 to +0.45V; logic ONE = +3 to +5V.

   (b) Input Current: Logic ZERO level of 0V = 1.66 Ma out; logic ONE level of +5V = 0.1 Ma in.

(c) Output Current: The output can sink 8.3 Ma, maximum, when output is at 0V; the output can supply 0.5 Ma, maximum, when output is at +3V.

(d) Rise and Fall Time: The maximum output rise and fall times, measured with full load at the signal conditioner output connector, equals 12 and 10 nanoseconds, respectively.

c. Input Power: 108 to 132 volts AC, 47 to 65 Hz, single-phase, 120 volts AC, 180 watts.

2.2.2 Outputs

a. Serial PCM Output Signal: Serial NRZC is available for all inputs previously specified having the following specifications.

1. Logic Levels--Logic ONE = +3V to +5V; logic ZERO = 0V to +0.45V.

2. Drive Capability--1.2 Ma, maximum, to the loads for a logic ONE level of +4.5V; 20 Ma, maximum, from the loads for a logic ZERO level of 0V.

3. Rise and Fall Times--0.1 microsecond, maximum.

b. Tape-Recorder Outputs: Serial NRZC, NRZM, or SØC independent of input code. Tape-recorder outputs have the following specifications.

1. Level--2 volts peak-to-peak ±20% centered within 20% of the peak-to-peak value of the signal.

2. Drive Capability--50-ohm coax terminated with a 50-ohm ±10% resistive load.

3. Rise and Fall Times--0.25 microsecond, maximum.

c. Bit-Rate Clock Outputs: Four separate pulse trains, synchronous with the serial PCM outputs as follows--

1. 0^{o} Clock: Positive-going edge in phase with the beginning of the bit period.

2. 90° Clock: Positive-going edge occurring after 1/4 of bit period.

3. 180° Clock: Positive-going edge occurring at mid-bit time.

4. 270° Clock: Positive-going edge occurring after 3/4 of bit period.

2.2.3 Synchronization

a. Loop-Filter Width: An analog phase-locked-loop tracking filter with three loop-width positions is provided to generate the bit-synchronization signal. Nominal loop widths are 0.3%, 1%, and 3% of the bit rate.

b. Deviation Meter: A front-panel deviation meter is provided to indicate the deviation between the input-bit rate and the selected bit-rate frequency.

c. Capture and Tracking Range: Three capture and tracking ranges are provided-- ±1%, ±3%, and ±10% of the bit rate.

d. SYNC Indicator: Loss-of-lock condition is indicated by a front-panel lamp and may be monitored at a pin on the rear connector.

e. Acquisition Time: The time required to achieve synchronization with the incoming signal is less than 100 bit periods for a capture range of ±10% with a phase-locked-loop width of 3%.

f. Transition Density: Synchronization is maintained with transition densities as low as one transition in 64 consecutive bits with a loop width of 0.3%.

g. Input-Bit Jitter: Synchronization is maintained in the presence of noncumulative input-bit jitter providing a bit displacement as great as ±20% of a bit period from the nominal bit position and at jitter rates as high as the bit rate.

h. Bit-Error Probability: No greater than the following figures when the PCM signal is added to gaussian white noise with a bandwidth greater than ten times the bit rate:

S/N Ratio (Db)	Square PCM With a Reset-Integrator Detector	Filtered PCM at 0.75 Bit Rate With a Filter-Sample Detector
6 Db	4×10^{-2}	7×10^{-2}
9 Db	6×10^{-3}	1.8×10^{-2}
12 Db	2×10^{-4}	1.5×10^{-3}

2.2.4 Controls

a. Programmable Functions: Bit rate, input polarity, type of detection (sample, filter-sample, reset integrator), recorder output code, phase-locked-loop width and tracking range, and input code.

b. Entry Mode:

1. Local Control--Front-panel programming switches.

2. Remote Control--18 computer interface lines as follows:

(a) Instruction Request (Input Request)--One line from the signal conditioner. The line is at a logic ONE level (+3V to +5V) when an instruction can be entered into the signal conditioner storage registers.

(b) Instructions--16 lines, consisting of a four-bit module address, a four-bit group address, and an eight-bit instruction command.

(c) Instruction Transfer (Strobe)--One line from the computer I/O device. When instruction request line is at a logic ONE level, a logic ONE strobe level from the computer transfers the data on the 16 instruction lines into the signal conditioner storage register. Strobe shall drop to logic ZERO level when instruction request line drops to logic ZERO level.

2.3 MECHANICAL SPECIFICATIONS

a. Width: 19 inches.

b. Height: 5-1/4 inches.

c. Depth: 22 inches behind front panel.

d. Mating Connectors: Supplied with equipment.

e. Cooling: Provided by Goldseal Muffin Fan manufactured by Rotron, internally mounted on the rear-panel assembly.

f. Mounting Hardware: Supplied with equipment.

g. Slide Mounting: Provisions for slide mounting are provided.

h. Weight: Net, 55 pounds. Shipping, 70 pounds.

i. Accessibility: All printed-wiring boards are removable from the top of the equipment after removal of the equipment from the rack.

j. Temperature Range: Operating, +10°C to +50°C circulating air. Storage, −55°C to +85°C.

SECTION 3

INSTALLATION AND OPERATION

3.1 INSTALLATION

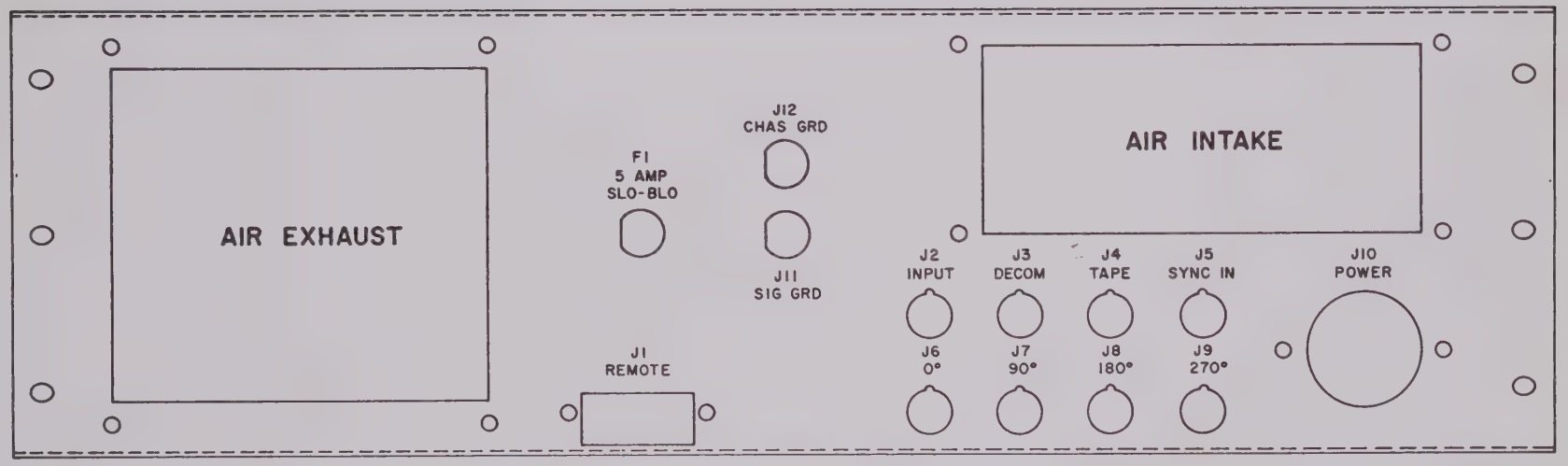
The signal conditioner is shipped completely assembled and ready for mounting. Any shortage or damage to the unit should be reported in accordance with the instructions of the EMR Purchase Order Acknowledgment (POA).

The signal conditioner is equipped with or without mounting slides, depending on the customer configuration requirement. Installation information for the available configurations is as follows:

a. Model 2721-01-0--Mounting slides not supplied with the unit. Installation is completed in accordance with the customer application.

b. Model 2721-01-1--Contains telescopic-type mounting slides for direct installation in a standard 19-inch equipment rack or portable-instrument case. After unpacking the unit, remove the mounting slides from the signal conditioner and mount the slides to the internal frame of the mounting equipment. Mounting hardware for this installation is supplied with each unit. Insert the signal conditioner into the slides until the unit is firmly seated. Turn-to-lock fasteners on either side of the front panel secure the unit in the mounting location. The signal conditioner may be extended from the rack for servicing by loosening the front-panel turn-to-lock fasteners and pulling the unit straight out. Pushbutton-stop latches are provided on the outside surfaces of both slides holding the unit at the maximum extension. At this point, the unit may be removed from the rack by depressing the pushbutton-stop latches and pulling the unit straight out.

After installing the signal conditioner in the mounting equipment, make all external electrical connections to connectors on the rear panel. The location of the rear-panel connectors is illustrated in Figure 3-1 and the type of connections to be terminated are described in Table 3-1.



NOTE:

1. EMR DRAWING CONTROL NO. 2721-006.

Figure 3-1. Location of Rear-Panel Connectors (See Table 3-1)

Table 3-1. Function of Rear-Panel Connectors (See Figure 3-1)

PANEL DESIG-NATION	PANEL NOMEN-CLATURE	CONNECTOR TYPE	FUNCTION
J1	REMOTE	52 Pin	Provides remote-control connections. (See Figure 3-2 for pin location and Table 3-2 for pin-function assign-ments.)
J2	INPUT	BNC	Serial PCM data-input jack.
J3	DECOM	BNC	NRZC output.
J4	TAPE	BNC	Variable code output for tape recorder.
J5	SYNC IN	BNC	Auxiliary synchronization pulse input.
J6	0^{o}	BNC	Bit-synchronized timing signal output 0^{o} phase.
J7	90^{o}	BNC	Bit-synchronized timing signal output 90^{o} phase.
J8	180^{o}	BNC	Bit-synchronized timing signal output 180^{o} phase.
J9	270^{o}	BNC	Bit-synchronized timing signal output 270^{o} phase.
J10	POWER	3 Pin	Supply primary power.
J11	SIG GRD	Binding Post	Signal-ground connection.
J12	CHAS GRD	Binding Post	Chassis-ground connection.

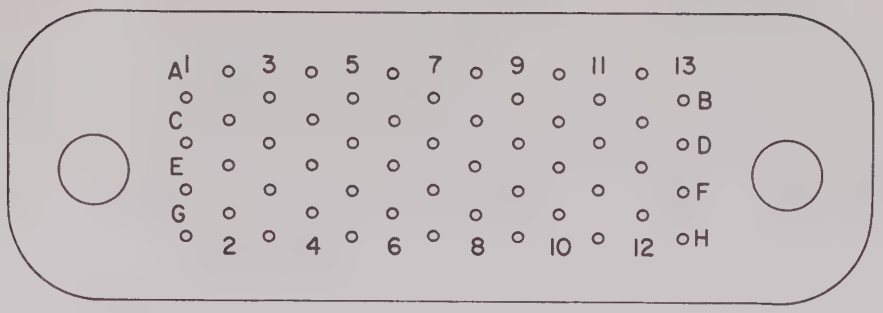


Figure 3-2. Remote Connector (A4J1) Pin Locations (See Table 3-2)

Table 3-2. Remote Connector A4J1, Signal Identification

PIN	SIGNAL
A4J1A2	Remote Instruction, Bit 1 (LSB)
A4J1B1	Ground
A4J1A4	Remote Instruction, Bit 2
A4J1B3	Ground
A4J1A6	Remote Instruction, Bit 3
A4J1B5	Ground
A4J1A8	Remote Instruction, Bit 4
A4J1B7	Ground
A4J1A10	Remote Instruction, Bit 5
A4J1B9	Ground
A4J1A12	Remote Instruction, Bit 6
A4J1B11	Ground
A4J1D13	Remote Instruction, Bit 7
A4J1B13	Ground
A4J1C2	Remote Instruction, Bit 8 (MSB)
A4J1D1	Ground

PIN	SIGNAL
A4J1C4	Remote Group Address, Bit 9 (LSB)
A4J1D3	Ground
A4J1C6	Remote Group Address, Bit 10
A4J1D5	Ground
A4J1C8	Remote Group Address, Bit 11 (MSB)
A4J1D7	Ground
A4J1C10	10V Range Light Output
A4J1D9	30V Range Light Output
A4J1C12	Module Address, Bit 13 (LSB)
A4J1D11	Ground
A4J1E2	Module Address, Bit 14
A4J1F1	Ground
A4J1E4	Module Address, Bit 15
A4J1F3	Ground
A4J1E6	Module Address, Bit 16 (MSB)
A4J1F5	Ground
A4J1E8	Instruction Transfer (Strobe)
A4J1F7	Ground

Table 3-2 (Cont'd.). Remote Connector A4J1, Signal Identification

PIN	SIGNAL
A4J1E10	Instruction (Input) Request
A4J1F9	Ground
A4J1E12	Remote-Status Output
A4J1F11	Ground
A4J1H13	Power-On Status Output
A4J1F13	Ground
A4J1G2	Sync-Status Output
A4J1H1	Ground

PIN	SIGNAL
A4J1G4	Remote-Deviation Meter +
A4J1H3	Remote-Deviation Meter –
A4J1G6	Remote-Level Meter +
A4J1H5	Remote-Level Meter –
A4J1G8	Not used
A4J1H7	Not used
A4J1G10	Not used
A4J1H9	Not used
A4J1G12	Not used
A4J1H11	Not used

3.2 OPERATION

3.2.1 Front-Panel Controls, Indicators, and Monitor Jacks

During local operation, the signal conditioner is operated and monitored using front-panel controls, indicators, and monitor jacks. Each of the front-panel components is illustrated in Figure 3-3 and functionally described in Table 3-3.

3.2.2 Operating Procedures

The Model 2721 Signal Conditioner can be operated in either of two modes:

a. Local--Manual mode of operation in which the unit is controlled by front-panel switches.

b. Remote--In this mode, the unit is controlled by remote-control lines from a computer.

Local operation of the signal conditioner is described in paragraph 3.2.2.1 and remote operation is described in paragraph 3.2.2.2.

3.2.2.1 Local Operation

a. Set CONTROL switch to LOCAL.

b. Set all LOCAL-PROGRAMMING switches to down position.

c. Depress POWER switch and observe that POWER switch illuminates.

d. Depress LAMP-TEST switch and observe that all programming indicators light.

e. Set LOCAL-PROGRAMMING GROUP-ADDRESS switch 1 to up position.

NOTE

When programming the operating bit-rate frequency, a number must always be programmed in the most-significant-digit position (see Figure 3-4). The number selected for this position must not be greater than 9.

f. Using LOCAL PROGRAMMING-INSTRUCTION switches 8 through 1, select the first two significant digits of the operating bit-rate frequency. Figure 3-4 illustrates

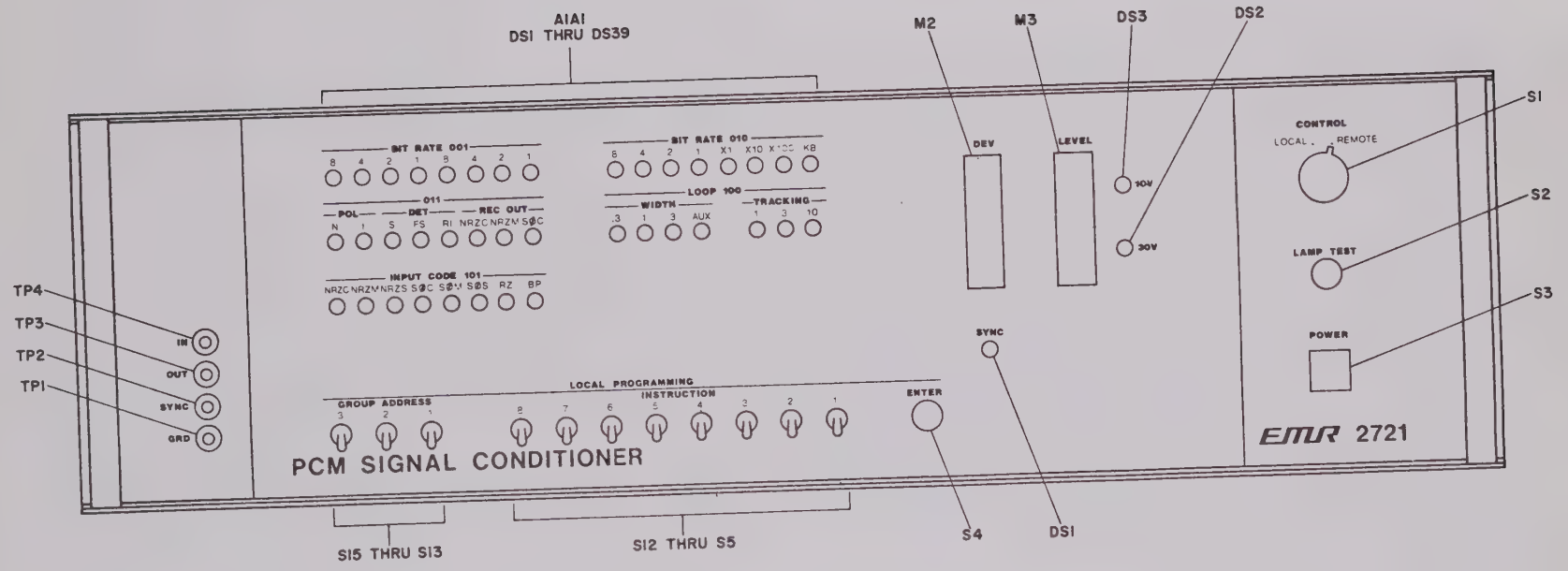


Figure 3-3. Model 2721 Signal Conditioner, Front-Panel Controls, Indicators, and Monitor Jacks

Table 3-3. Function of Front-Panel Controls, Indicators, and Test Jacks (See Figure 3-3)

PREFIX	NAME	DESCRIPTION
TP1	GRD Test Jack	Provides front-panel access to signal ground.
TP2	SYNC Test Jack	Provides front-panel access to the 0° bit-synchronization timing signal applied to 0° jack (A4J6).
TP3	OUTPUT Test Jack	Provides front-panel access to the NRZC output applied to the DECOM jack (A4J3).
TP4	INPUT Test Jack	Provides front-panel access to the serial PCM data input to the Model 2721.
A1DS1 thru A1DS39	Programming Status Indicators	Provides visual indication of the Model 2721 operating parameters selected by LOCAL PROGRAMMING switches or by remote programming from computer I/O device.
	---BIT RATE 010---	
DS1	KB Indicator	Provides visual indication of the X1000 multiplication factor used to establish bit-rate frequency.
DS2	X100 Indicator	Provides visual indication of the X100 multiplication factor used to establish bit-rate frequency.
DS3	X10 Indicator	Provides visual indication of the X10 multiplication factor used to establish the bit-rate frequency.
DS4	X1 Indicator	Provides visual indication of the X1 (bits) multiplication factor used to establish the bit-rate frequency.
DS5 thru DS8	1, 2, 4, 8 Bit-Rate Indicators	Provides a visual BCD display of the third most-significant digit in the selected bit-rate frequency.

Table 3-3 (Cont'd.). Function of Front-Panel Controls, Indicators, and Test Jacks

PREFIX	NAME	DESCRIPTION
	---BIT RATE 001---	
DS9 thru DS12	1, 2, 4, 8 Bit-Rate Indicators	Provides a visual BCD display of the second most-significant digit in the selected bit-rate frequency.
DS13 thru DS16	1, 2, 4, 8 Bit-Rate Indicators	Provides a visual BCD display of the first most-significant digit in the selected bit-rate frequency.
	---LOOP 100---	
DS17 thru DS19	TRACKING, 10, 3, 1 Indicators	Provides a visual indication of the selected-internal VCO tracking range expressed in percent. NOTE When tracking range is not selected either locally or remotely, a tracking range of 3% is automatically selected but is not indicated by lamp.
DS20 thru DS23	WIDTH, Aux., 3, 1, .3 Indicators	Provides a visual indication of the selected-filter loopwidth expressed in percent. Loop filter is used in conjunction with phase-lock-loop control of the internal bit-rate frequency. AUX indicator is lighted when external-clock signal is selected to control the phase detector in the phase-lock loop. NOTE When loopwidth is not selected either locally or remotely, a loopwidth of 1% is automatically selected but not indicated by lamp.

Table 3-3 (Cont'd.). Function of Front-Panel Controls, Indicators, and Test Jacks

PREFIX	NAME	DESCRIPTION
	---011---	
DS24 thru DS26	REC OUT -- SØC, NRCM, NRZC Indicators	Provides a visual indication of the code selected for the serial PCM output to the tape recorder.
DS27 thru DS29	DET -- R1, FS, S Indicators	Provides a visual indication of the type of signal filtering (reset integrator, filter sample, sample) selected.
DS30 and DS31	POL -- I, N Indicators	Provides a visual indication of the input-signal polarity selected.
	---INPUT CODE 101---	
DS32 thru DS39	BP, RZ, SØS, SØM, SØC, NRZS, NRZM, NRZC	Provides a visual indication of the PCM input-code selected.
M2	DEV Meter	Provides a visual indication, in percent, of the frequency difference between the incoming serial PCM and the selected bit rate.
M3	LEVEL Meter	Provides visual display of the peak-to-peak amplitude of serial PCM input.
DS3	10V Light	Provides visual indication of the full-scale (low range) deflection voltage of input-LEVEL meter M3.
DS2	30V Light	Provides visual indication of the full-scale (high range) deflection voltage of input-LEVEL M3.
S1	CONTROL Switch LOCAL-REMOTE	Selects the operating mode of the Model 2721. In LOCAL position, Model 2721 is controlled by front-panel switches. In REMOTE position, Model 2721 is controlled by external computer I/O device.
S2	LAMP TEST Pushbutton Switch	When depressed, lights all local programming indicators to check operation of lamps.

Table 3-3 (Cont'd.). Function of Front-Panel Controls, Indicators, and Test Jacks

PREFIX	NAME	DESCRIPTION
S3	POWER Switch	Controls primary-power input to Model 2721.
DS1	SYNC (LOSS-LOCK) Indicator	Provides a visual indication of the synchronization status of the unit. SYNC indicator lights when Model 2721 loses synchronization.
S4	ENTER Pushbutton Switch	When depressed, enters the instructions selected by LOCAL PROGRAMMING switches into signal-conditioner storage registers.
S5 thru S12	LOCAL PROGRAMMING INSTRUCTION Switches 1 through 8	In LOCAL operating modes, switches are used in conjunction with GROUP ADDRESS switches to program the various operating parameters of the Model 2721. Each of the eight INSTRUCTION switches is functionally related to a similarly-positioned programming status indicator in each functional group of eight indicators selected by GROUP ADDRESS switches. NOTE INSTRUCTION switch 4 is not operational when group address 100 is selected. When the ENTER pushbutton is pressed, a logic ONE level is stored in the signal-conditioner storage registers for each INSTRUCTION switch in the up position and a logic ZERO level is stored for each switch in the down position.

Table 3-3 (Cont'd.). Function of Front-Panel Controls, Indicators, and Test Jacks

PREFIX	NAME	DESCRIPTION
S13 thru S15	LOCAL PROGRAMMING GROUP ADDRESS Switches	In LOCAL operating mode, switches are used to select signal-conditioner functions to be programmed by INSTRUCTION switches. When the ENTER push-button is pressed, a logic ONE level is stored for each GROUP ADDRESS switch in up position and a logic ZERO level is stored for each GROUP ADDRESS switch in the down position. The group address codes are printed above each group of programming status indicators.

the selection of the first two most-significant digits of a bit-rate frequency of 52.9 Kb. In the example illustrated, the first most-significant digits selected represent 5.2 and require that the X10 multiplier be selected in the next bit-rate frequency instruction programmed.

Figure 3-4. Bit-Rate Selection -- First Two Most-Significant Digits

g. Momentarily depress ENTER switch to store programmed instruction.

h. Set all LOCAL PROGRAMMING switches to down position.

NOTE

When it becomes necessary to reprogram an instruction which has been entered into storage, the appropriate group address is selected and all instructions associated with the selected group address must be reprogrammed.

i. Set LOCAL PROGRAMMING GROUP ADDRESS switch 2 to up position.

j. Using LOCAL PROGRAMMING INSTRUCTION switches, select the third most-significant digit and multiplier of operating bit-rate frequency. Figure 3-5 illustrates the selection of the third most-significant digit and multiplier of a bit-rate frequency of 52.9 Kb.

Figure 3-5. Bit-Rate Selection, Third Most-Significant Digit and Multiplier

k. Momentarily depress ENTER switch to store programmed instruction.

l. Set all LOCAL PROGRAMMING switches to down position.

m. Set LOCAL PROGRAMMING GROUP ADDRESS switches 1 and 2 to up position.

n. Using LOCAL PROGRAMMING INSTRUCTION switches, select the operating input-signal polarity, the type of signal detection desired, and the recorder-output code required. Figure 3-6 illustrates the selection of normal input-signal polarity, filter-sample detection, and NRZM recorder signal-output code.

Figure 3-6. Input-Signal Polarity, Detection and Recorder Signal-Output Code Selection

o. Momentarily depress ENTER switch to store programmed instruction.

p. Set all LOCAL PROGRAMMING switches to down position.

NOTE

If loop width and tracking instructions are not programmed, the signal conditioner automatically provides a loop width of 1% and a tracking range of 3%.

q. Set LOCAL PROGRAMMING GROUP ADDRESS switch 3 to up position.

r. Using LOCAL PROGRAMMING INSTRUCTION switches, select the operating-loop width and tracking range. Figure 3-7 illustrates the selection of a 0.3% loop width and a tracking range of 1%.

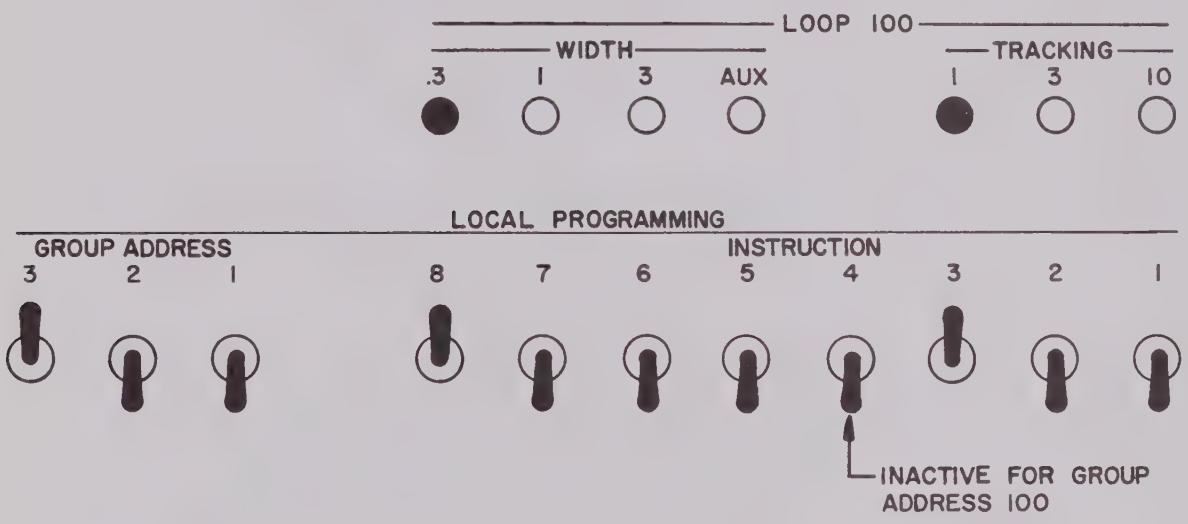


Figure 3-7. Loop Width and Tracking Range Selection

s. Momentarily depress ENTER switch to store programmed instruction.

t. Set all LOCAL PROGRAMMING switches to down position.

u. Set LOCAL PROGRAMMING GROUP ADDRESS switches 1 and 3 to up position.

v. Using LOCAL PROGRAMMING INSTRUCTION switches, select operating input signal code. Figure 3-8 illustrates the selection of an NRZM input-signal code.

Figure 3-8. Input-Signal Code Selection

w. Momentarily depress ENTER switch to store programmed instruction.

x. Set all LOCAL PROGRAMMING switches to down position.

y. Observe that SYNC light is extinguished and that DEV meter indicates approximately mid-scale.

NOTE

Illumination of the SYNC light and an off-scale (red zone) indication on the DEV meter indicates that the incoming bit-rate frequency is not within the selected tracking range. If necessary, select wider tracking range to acquire signal.

z. Observe that LEVEL meter indicates at least 0.5 volt peak-to-peak.

NOTE

Signal conditioner must be in synchronism with incoming PCM signal (SYNC light extinguished) to obtain an accurate LEVEL-meter indication.

3.2.2.2 Remote Operation

a. Set CONTROL switch to REMOTE.

b. Depress POWER switch and observe that POWER switch illuminates.

c. Depress LAMP TEST switch and observe that all programming indicators light.

d. Insure that the following signal-conditioner status signals are at the computer I/O device.

1. Power on.

2. Remote output.

3. Input request.

e. Transmit the instructions in the format and sequence illustrated in Figure 3-9. Refer to Table 3-2 for interfacing-signal connections. The specifications for the interfacing-control signals are listed in Section 2.

NOTE

If loop width and tracking instructions are not programmed, a loop width of 1% and tracking range of 3% are automatically provided.

NOTE

The four-bit module address code is selected by the user and determined by jumper wires on the EMR Part No. 11384 Control Card No. 1, Printed-Circuit Card. The card is located in A2J17 (refer to Figure 1-2). Refer to card-circuit description in Section 4 for code-selection procedure.

MODULE ADDRESS				GROUP ADDRESS				INSTRUCTION							
16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
				0	0	0	1	BIT RATE 8	4	2	1	.8	4	2	1
				0	0	1	0	BIT RATE 8	4	2	1	X1	X10	X100	KB
SEE NOTE				0	0	1	1	POL N	I	S	DETECTOR FS	RI	REC OUTPUT NRZC	NRZM	SØC
				0	1	0	0	LOOP WIDTH 3	1	3	AUX	0	TRACKING 1	3	10
				0	1	0	1	INPUT CODE NRZC	NRZM	NRZS	SØC	SØM	SØS	RZ	BP

Figure 3-9. Model 2721 Signal Conditioner Remote Programming Format

f. On signal conditioner, observe that SYNC light is extinguished and that DEV meter indicates approximately mid-scale.

NOTE

Illumination of the SYNC light and an off-scale (red zone) indication on the DEV meter indicates that the incoming bit-rate frequency is not within the programmed tracking range. If necessary, reprogram wider tracking range to acquire signal.

g. On signal conditioner, observe that LEVEL meter indicates at least 0.5 volts peak-to-peak.

NOTE

Signal conditioner must be in synchronism with incoming PCM signal (SYNC light extinguished) to obtain an accurate LEVEL-meter indication.

SECTION 4

THEORY OF OPERATION

4.1 GENERAL

This section contains the functional theory of operation for the Model 2721 Signal Conditioner. The theory discussion is presented at two levels: General and detailed. The general theory of operation is presented in paragraph 4.2 with reference to the simplified block diagram illustrated in Figure 4-1. The detailed theory of operation is presented in paragraph 4.3 with reference to the detailed block and schematic diagrams contained in this section.

Many of the signal-conditioner circuits utilize integrated-circuit modules. These modules contain digital logic gates, amplifier circuits, comparators, level-shifting gates and driver gates. A description of each module type and the operation of each module circuit is provided in Figures 4-40 through 4-47

4.2 GENERAL THEORY OF OPERATION

The Model 2721 Signal Conditioner shown in Figure 4-1 accepts any one of the serial PCM data inputs illustrated in Figure 4-2, recovers the PCM data from any inherent noise, converts the PCM data to a serial-NRZC output code, and generates timing signals in synchronism with the PCM output data. In addition, the signal conditioner provides noise-free NRZC, NRZM, or SØC outputs for recording. Storage registers within the signal conditioner receive and store all operating instructions and permit the signal conditioner to be operated locally by front-panel switches or remotely by a computer I/O device. The contents of the instruction-storage registers operate relays which set up the operating parameters of the Model 2721. The signal-conditioner operating status is displayed by front-panel indicators.

As shown in Figure 4-1, the Model 2721 performs the following six major functions when signal conditioning the serial PCM data input.

a. Input Conditioning: Establishes the bit levels required for further signal processing in the unit.

b. Filtering: Removes the noise content of the serial PCM data input.

c. Bit Synchronization: Acquires bit synchronization with the incoming serial PCM data and generates four synchronous bit-timing pulse trains for use by external equipment.

d. Bit-Decision/Reconstruction: Provides DC restoration and reconstruction of the filtered-serial PCM data.

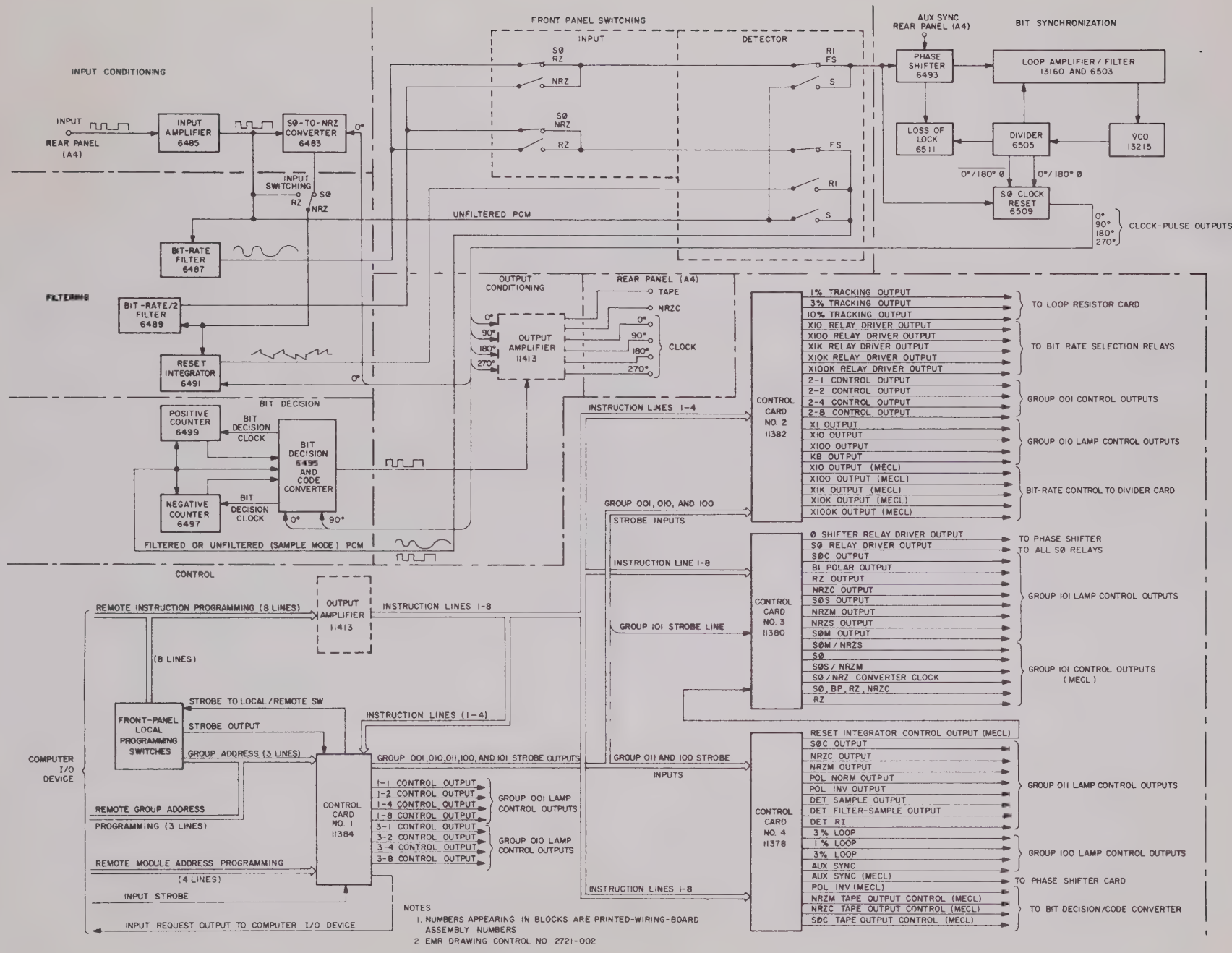
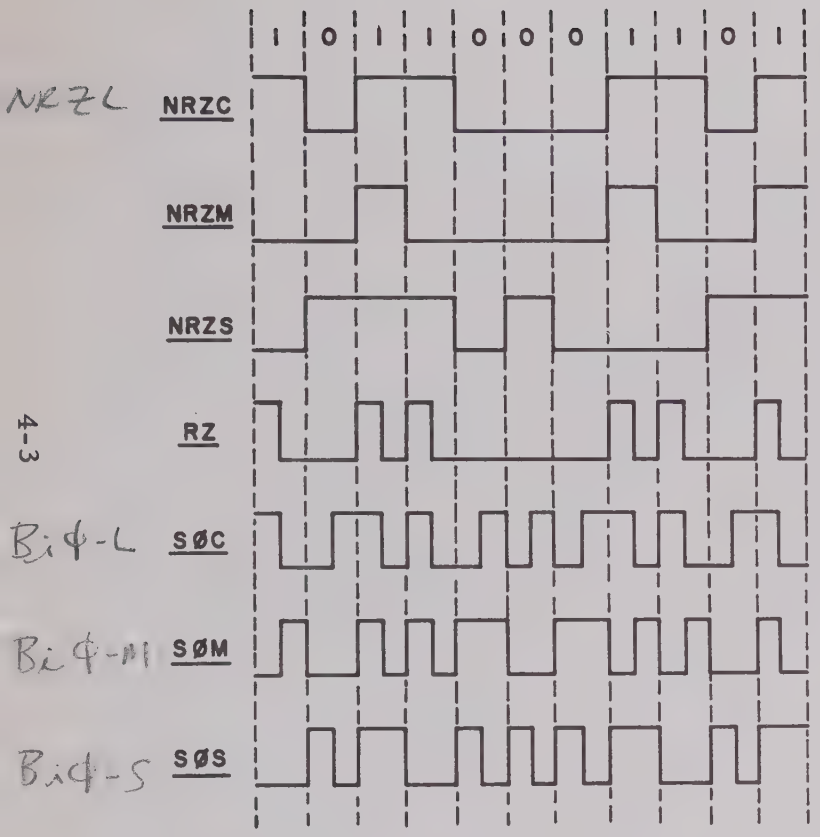


Figure 4-1. Model 2721 Signal Conditioner, Block Diagram



NRZ-CHANGE:
"ONE" IS REPRESENTED BY ONE LEVEL;
"ZERO" IS REPRESENTED BY THE OTHER LEVEL.

NRZ-MARK:
"ONE IS REPRESENTED BY A CHANGE IN LEVEL;
"ZERO" IS REPRESENTED BY NO CHANGE IN LEVEL.

NRZ SPACE:
"ONE" IS REPRESENTED BY NO CHANGE IN LEVEL;
"ZERO" IS REPRESENTED BY A CHANGE IN LEVEL.

RZ:
"ONE" IS REPRESENTED BY A HALF-BIT-WIDE PULSE;
"ZERO" IS REPRESENTED BY NO PULSE.

SPLIT-PHASE-CHANGE:
A TRANSITION OCCURS AT CENTER OF EVERY BIT PERIOD;
"ONE" IS REPRESENTED BY A "ONE" LEVEL WITH THE TRANSITION TO THE "ZERO" LEVEL;
"ZERO" IS REPRESENTED BY A "ZERO" LEVEL WITH THE TRANSITION TO THE "ONE" LEVEL.

SPLIT-PHASE-MARK:
A TRANSITION OCCURS AT THE BEGINNING OF EVERY BIT PERIOD;
"ONE" IS REPRESENTED BY A MIDBIT TRANSITION;
"ZERO" IS REPRESENTED BY NO MIDBIT TRANSITION.

SPLIT-PHASE-SPACE:
A TRANSITION OCCURS AT THE BEGINNING OF EVERY BIT PERIOD;
"ONE" IS REPRESENTED BY NO MIDBIT TRANSITION;
"ZERO" IS REPRESENTED BY A MIDBIT TRANSITION.

Figure 4-2. Input Signals Timing Diagram and Glossary

e. Code Conversion: Converts the reconstructed serial PCM data to an NRZC output for use by a decommutator and to serial NRZ (C or M) or SØC for recording.

f. Output Conditioning: Provides amplification and buffering for the Model 2721 output signals.

Serial PCM data is applied to the input amplifier through the Model 2721 rear-panel INPUT connector. The input amplifier removes any DC offset from the input signal and establishes the data-bit levels required for further signal processing in the unit. Split-phase coded PCM signals are level conditioned in the input amplifier and applied to the SØ-to-NRZ converter where the signals are converted to NRZ format for better signal-to-noise performance. The input amplifier and SØ-to-NRZ converter outputs are square-sided serial PCM wavetrains with the initial noise content intact.

The distribution of the input amplifier and SØ-to-NRZ outputs is determined by the Input and Detector Modes selected by local front-panel switching or by remote programming. Switching of the signal path is accomplished by relays. Figure 4-1 illustrates the signal path and simplified relay closures for filter-sample (FS) detection of a split-phase (SØ) serial PCM input.

The serial PCM data from the input conditioning circuits is applied to the filtering circuits consisting of two constant-time-delay filters and a reset integrator. Since the RZ signal frequency spectrum is twice as wide as that of an NRZ signal of the same bit rate, separate filters are used for RZ and NRZ signals. All three filters use variable RC filter networks. The cutoff frequencies of the variable RC filter networks are determined by the selected bit rate. The bit-rate filter accepts the serial PCM output from the input amplifier, removes the noise content, and provides a sinusoidal serial data wavetrain output centered around ground. The bit-rate/2 filter and the reset integrator accept either the serial PCM output from the input amplifier or the serial NRZ-coded PCM output from the SØ-to-NRZ converter. The bit-rate/2 filter provides a filtered sinusoidal serial data wavetrain centered around ground and the reset integrator provides a triangular data wavetrain centered around ground. Energized input and detector relays select the filter outputs applied to the bit-synchronization and bit-decision circuits.

The bit-synchronization circuits accept the selected filtered PCM output from the input-conditioning circuits and generate bit-rate clock pulses in synchronism with the bit rate of the serial PCM input to the Model 2721. The bit-rate generator is a null-seeking loop comprising a phase shifter, a loop amplifier/filter, a VCO, and a frequency-divider circuit. The initial VCO operating frequency, loop width, and the tracking range are selected by the front-panel INSTRUCTION switches or by remote programming. The bit-rate frequency selected places the null-seeking loop in operation at the expected bit-rate frequency of the incoming serial PCM data. The selected serial PCM wavetrain from the filtering circuits is applied to the phase-shifter circuits where the filtered sinusoidal PCM is converted to square-sided PCM data at the bit rate. The loop amplifier/-filter compares the serial PCM data output from the phase shifter with the

bit-rate frequency from the divider circuits. Any deviation between the two frequencies causes a correction voltage to be applied to the VCO. The VCO senses the correction voltage and changes frequency accordingly. The shift in VCO output frequency causes a corresponding change in the bit-rate frequency output from the divider circuitry. The process of comparing the bit-rate frequency from the divider circuit with the serial PCM output from the phase shifter is continuous as the null-seeking loop changes the Model 2721 internal bit-rate frequency to correspond to any changes in the incoming serial PCM data bit rate. Selectable loop widths and tracking ranges are provided to enable the bit-rate generator to acquire synchronization with the incoming bit rate under low signal-to-noise and high jitter-rate conditions. Loop widths of 0.3%, 1%, or 3% and tracking ranges of 1%, 3%, or 10% are selectable by local or remote programming and control the operation of the null-seeking loop.

The SØ clock reset circuits accept 0^{o} and 90^{o} outputs from the divider network and generate four separate timing-pulse trains of 0^{o}, 90^{o}, 180^{o}, and 270^{o} for use as internal timing and for application through the signal-conditioner rear connector to external equipment. For all serial PCM input codes except split phase, the SØ clock reset circuits are slaved to the divider circuit outputs. When split-phase coded serial PCM data is applied to the bit-synchronization circuits, the SØ clock reset circuits phase relate the internal timing pulse trains with the bit transitions of the split-phase coded serial PCM input.

The loss-of-lock circuits compare the internal bit-rate frequency output from the divider with the serial PCM data output from the phase-shifter circuits. Absence of transitions in the incoming serial PCM data is counted as "misses" or no-correlation. A transition in the incoming serial PCM data, occurring in coincidence with the internal bit-rate frequency, resets the loss-of-lock circuitry to the lock state. An eight-bit binary counter is used to count "misses The counter must count 64 consecutive misses prior to the generation of a loss-of-lock indication. A loss-of-lock condition lights the SYNC lamp on the signal-conditioner front panel and applies a negative-going voltage to a remote-control line.

The bit-decision circuits restore sinusoidal serial PCM outputs from the filtering circuits to DC levels and convert the reconstructed data to NRZC-coded serial PCM for application to external equipment. In addition, the included code-conversion circuits provide an NRZC, NRZM, or SØC serial PCM output for recording on magnetic tape. The bit-decision circuits include a positive counter, a negative counter, and a bit-decision and code converter. The serial PCM data applied to the bit-decision network may be sinusoidal, triangular or square sided depending upon the selected detector mode. The positive and negative counters utilize an eight-bit digital-to-analog converter (DAC) to sense the incoming serial PCM data-signal excursions about ground. The incoming serial PCM data may be either a logic ONE or a logic ZERO level; therefore, bit-decision sampling must occur during the positive or negative peak excursion for the proper reconstruction of the incoming serial PCM data. The output from the bit-decision network is NRZ-coded serial PCM. The included code-conversion circuits convert the NRZ-coded PCM output from the

bit-decision network to NRZC-coded serial PCM and to the selected recorder PCM output code. The code-conversion circuit outputs are applied to the output-conditioning circuits.

The output-conditioning circuits provide amplification and buffering for the Model 2721 output signals. Level conditioning is also performed in the output-conditioning circuits. The buffered, level-conditioned outputs from the output-conditioning circuits are applied to rear-panel connectors.

4.3 DETAILED THEORY OF OPERATION

The detailed theory of operation for the Model 2721 PCM Signal Conditioner is presented at the circuit card level with reference to the individual printed-wiring board schematics. The individual integrated-circuit modules used on the various printed-circuit cards are illustrated schematically and described at the end of this section.

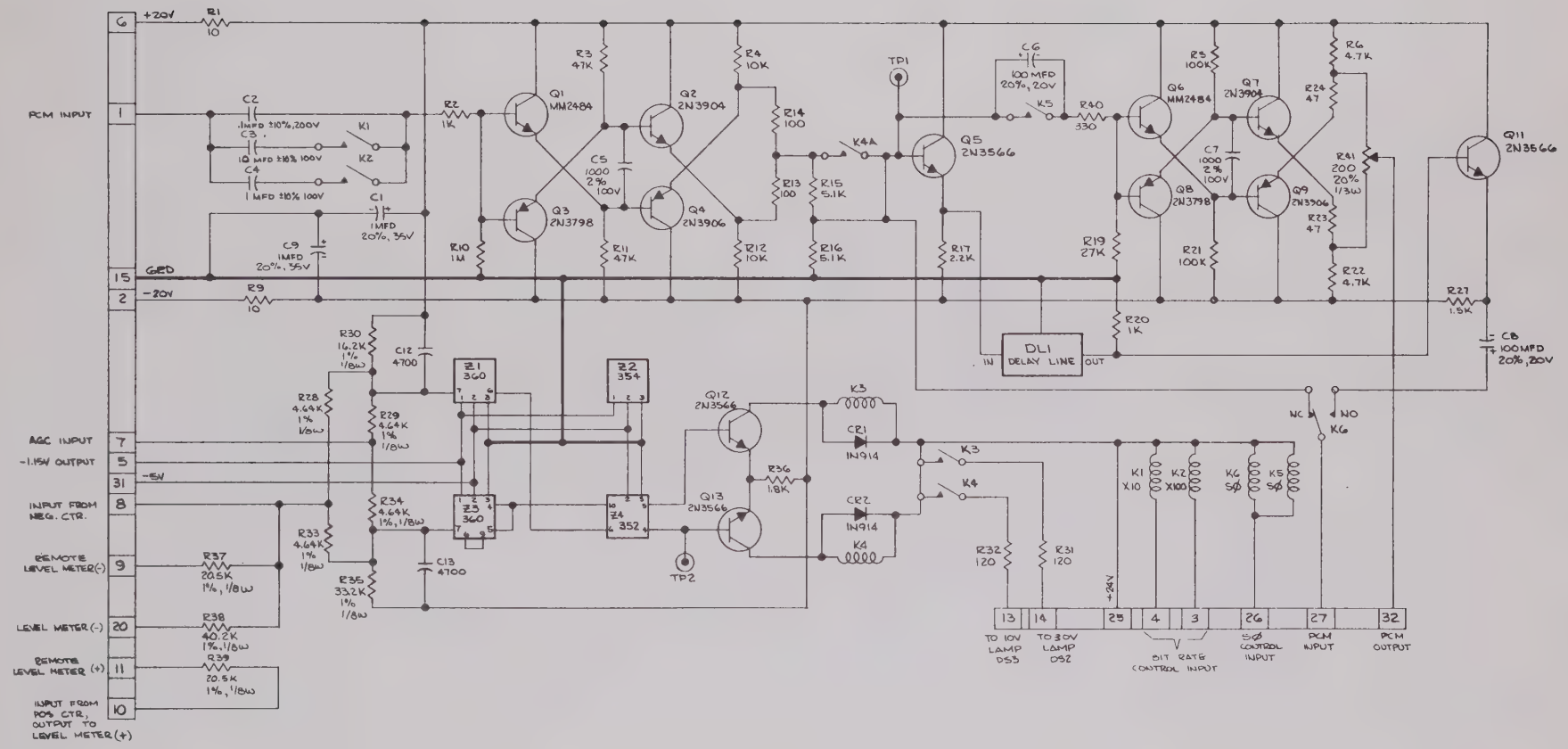
4.3.1 Input Amplifier (See Figure 4-3)

The input-amplifier printed-wiring board (assembly no. 6485) is located in the card-file subassembly (A2) card slot 1 (J1). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The main function of the input-amplifier circuitry is to change the data bit levels of incoming serial PCM data and provide an output PCM signal compatible with other circuits in the Model 2721.

Incoming serial PCM data is applied to pin 1 and AC coupled to emitter-follower Q1-Q4. The amount of AC coupling is dependent upon the bit rate selected and is selected by relay contact closures. The output of emitter-follower Q1-Q4 is applied to the normally closed contacts of relay K6 and coupled to emitter-followers Q5 and Q6-Q9.

The output of emitter-follower Q5 is applied through a delay line, emitter-follower Q11, and AC coupled to the normally open contact of relay K6. Relay K6 is energized for a SØ PCM input only and its output is applied to pin 27. The input to emitter-follower Q6-Q9 is DC coupled for all modes of operation except SØ. The PCM output from emitter-follower Q6-Q9 is balanced around ground by R41 and applied to output pin 32.

An automatic-signal attenuator circuit controls the amplitude of the signal applied to the base of emitter-follower Q5. When the peak-to-peak amplitude of the input PCM signal is below approximately 9 volts, relay K4 is energized and resistor R15 is shunted out of the circuit by the K4A relay contacts. When the peak-to-peak amplitude of the PCM signal input exceeds the 9-volt threshold, the automatic-signal attenuator circuit deenergized relay K4 and resistor R15 is placed in series with the input to Q5. Series resistor R15 effectively attenuates the peak-to-peak amplitude of the PCM input signal by one-third.



NOTES:
(UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTOR VALUE ARE IN OHMS (K=1000) ±5%, 1/4 WATT.
2. ALL CAPACITOR VALUE ARE IN PICOFARADS ±5%, 500 VOLTS.

Figure 4-3. Input Amplifier Card, (Sheet 1 of 2)

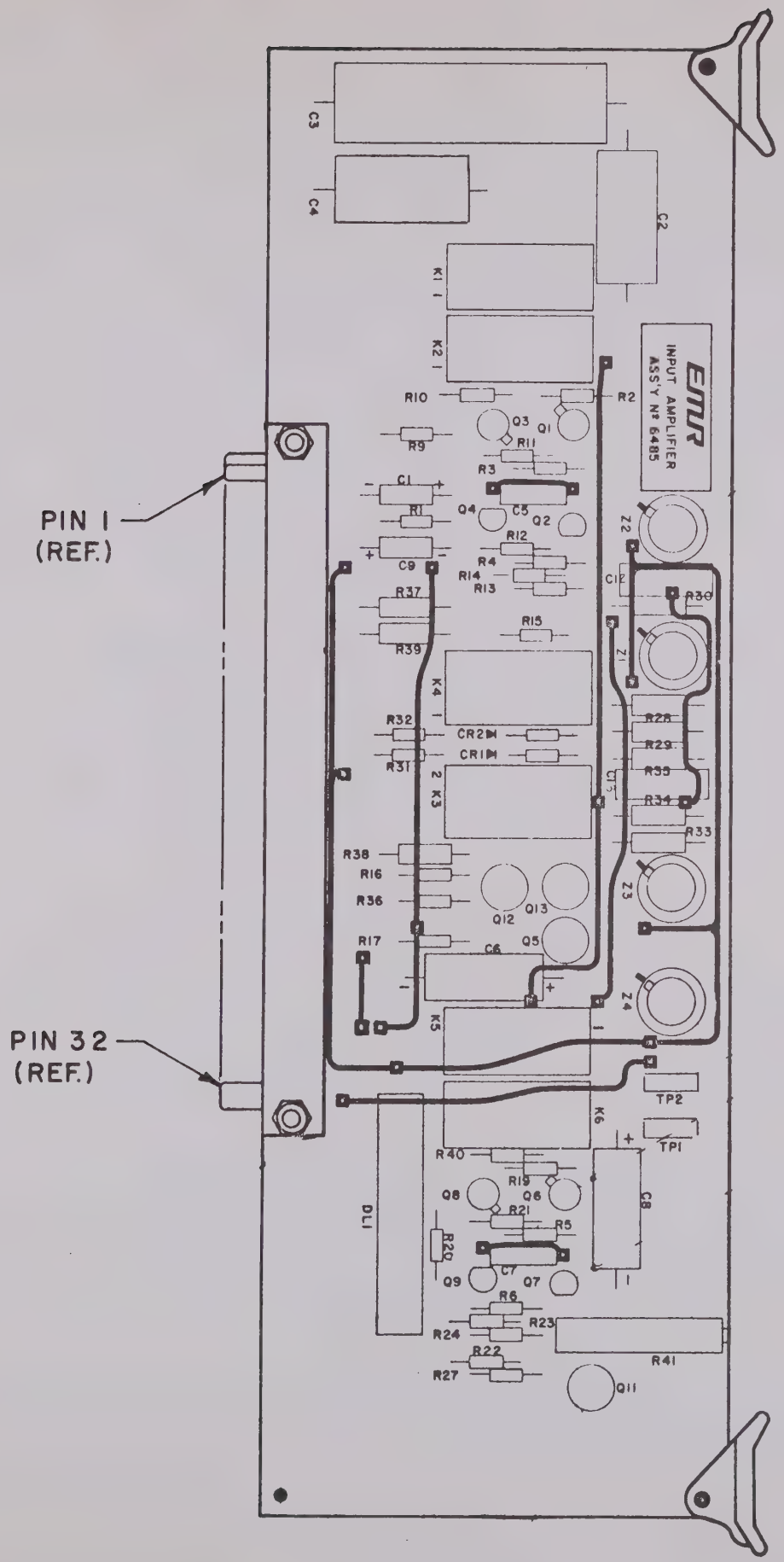


Figure 4-3. Input Amplifier Card, (Sheet 2 of 2)

Relays K3 and K4 are operated by the automatic attenuator circuit consisting of divider network R28 through R30 and R33 through R35, integrated-circuit modules Z1 through Z4, and relay-driver transistors Q12 and Q13. Dual two-input NOR-gate modules Z1 and Z3 provide complementary inputs to set-reset flip-flop module Z4. Bias driver module Z2 provides the proper biasing levels to modules Z1 through Z3. An AGC input from the emitter-follower on the positive counter card is applied to the resistive-divider network at pin 7 and a DC input from the negative counter is applied to the network at pin 8. These two DC inputs represent the peak-to-peak amplitude of the serial PCM input to the Model 2721. When the PCM signal input is below 9 volts peak-to-peak, two-input NOR-gate modules Z1 and Z3 receive logic ONE level (0.7V) inputs. Module Z1 applies a logic ZERO level to the set input (pin 67 of set-reset flip-flop module Z4) and module Z2 applies a logic ONE level to the reset input to the flip-flop. The logic ONE level at the $\overline{Q}$ output (pin 4) turns on relay driver Q13 and energizes relay K4. Relay K4 lights the 10V range indicator lamp for the front-panel LEVEL meter and shunts attenuator resistor R15 as previously described.

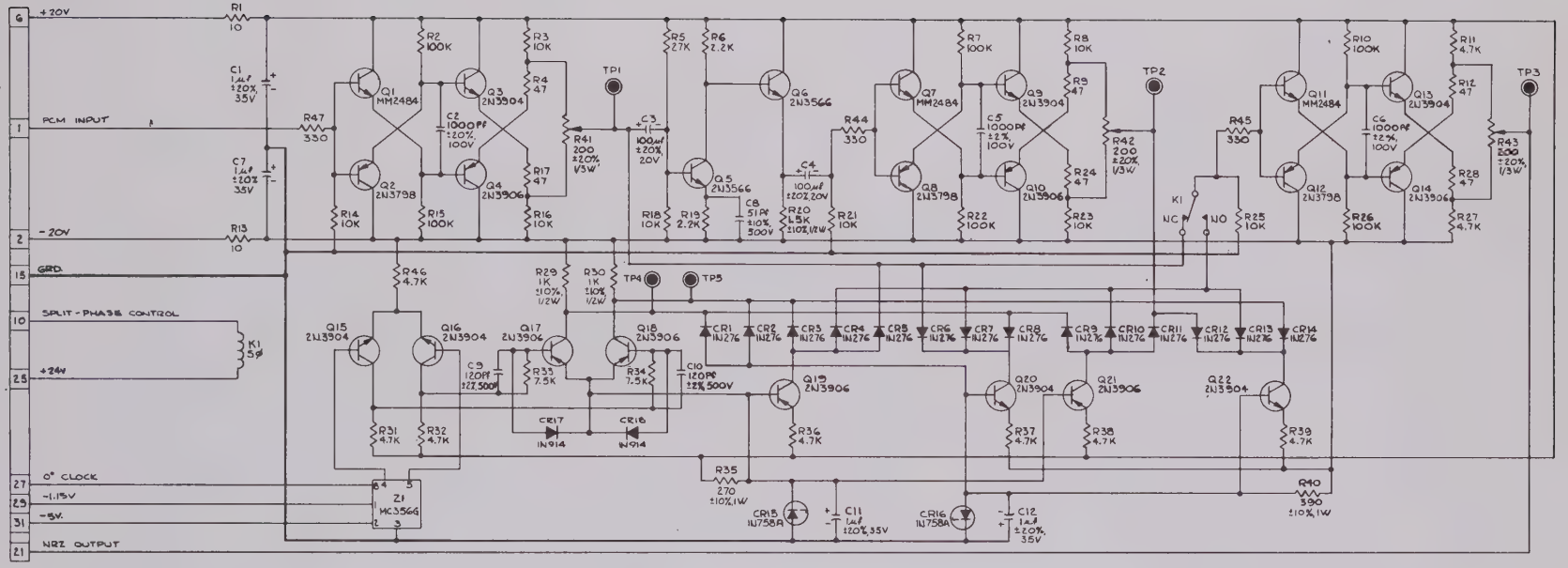
When the PCM signal input exceeds 9 volts peak-to-peak, logic ZERO levels (−1.5V) are applied to modules Z1 and Z3 and the logic-level inputs to the set-reset flip-flop module Z4 reverse polarity. The logic zero level at the $\overline{Q}$ output (pin 4) cuts off relay driver Q13 and deenergizes relay K4. When K4 deenergizes the 10V range indicator for the LEVEL meter extinguishes and resistor R15 is placed in series with the signal input to Q5. The logic ONE level at the Q output (pin 5) turns on relay driver Q12. Relay driver Q12 energizes relay K3 and lights the 30V range indicator for the LEVEL meter.

4.3.2 Split-Phase-to-NRZ Converter (Ref. Figure 4-4)

The split-phase-to-NRZ converter printed-wiring board (assembly no. 6483) is located in the card-file subassembly (A2) card slot 2 (J2). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The main function of the SØ-to-NRZ converter circuitry is to convert incoming SØ serial PCM data to NRZ when the Model 2721 is operating in a SØ input mode.

The SØ serial PCM input is applied to pin 1 and DC coupled to emitter-follower Q1-Q4. The emitter-follower output is balanced around ground by R41 and applied to the SØ-to-NRZ gating network (Z1, Q15-Q22, and CR1 through CR14). It is also AC coupled to inverting amplifier Q5-Q6, buffered by emitter-follower Q7-Q10, and applied to the SØ-to-NRZ gating network. Emitter-follower Q7-Q10 output is balanced around ground by R42.

Opposite polarities of the incoming SØ serial PCM data are made available to the SØ and NRZ gating network at TP1 and TP2. The 0° clock input at pin 27 is applied to module Z1. Z1 provides 0° and 180° timing signals to the gating network at TP4 and TP5. The timing relation of the SØ-to-NRZ converter circuitry is shown in Figure 4-5.



NOTE:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4W.
2. EMR DWG. NO. 1138B, REV. B

Figure 4-4. Split Phase-To-NRZ Converter, (Sheet 1 of 2)

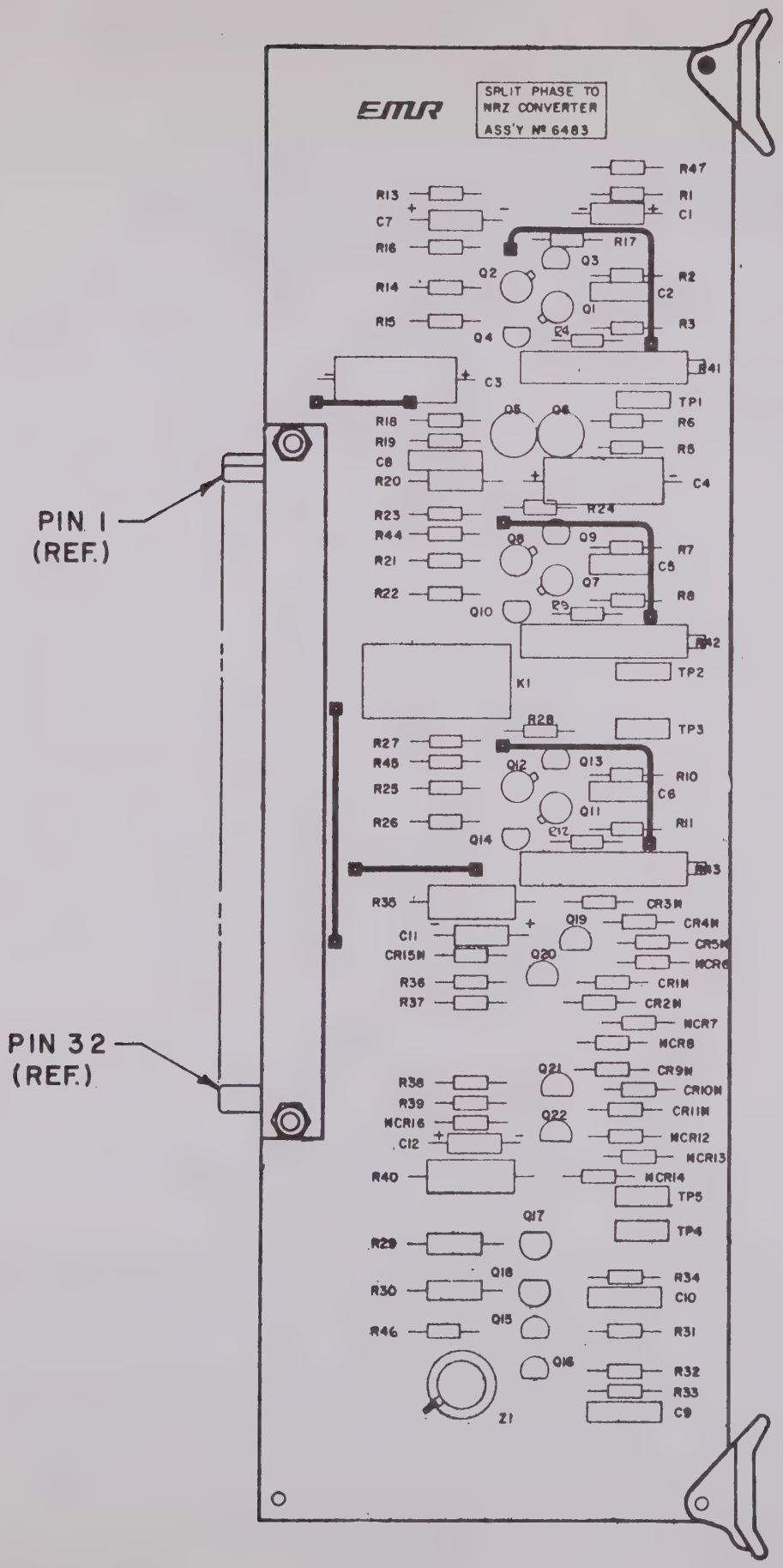


Figure 4-4. Split Phase-To-NRZ Converter, (Sheet 2 of 2)

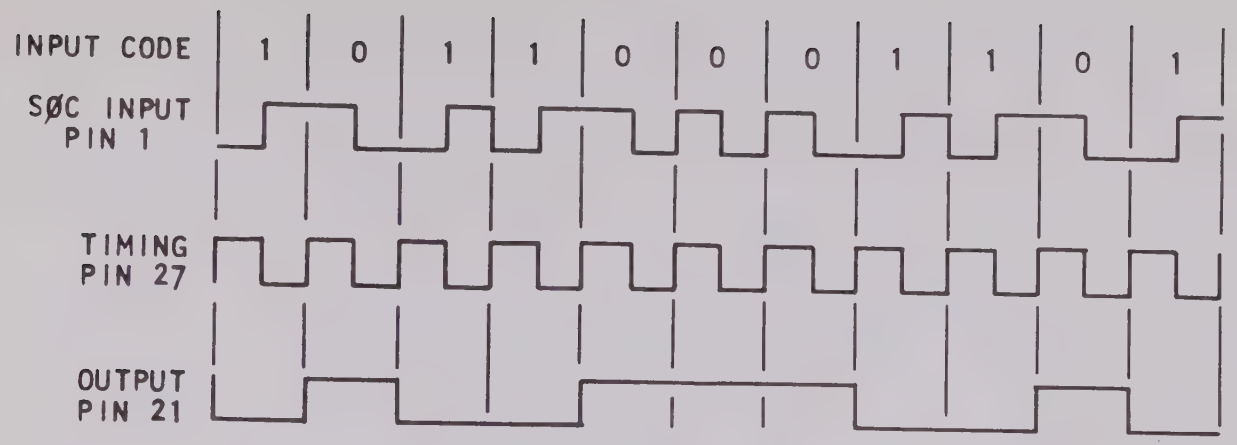


Figure 4-5. Split-Phase-to NRZ Converter Timing

The SØ-to-NRZ gating network consists of two demodulator bridges and associated constant-current-source transistors. The SØ signal output at TP1 is applied to a demodulator bridge consisting of diodes CR3 through CR8 and constant-current-source transistors Q19 and Q20. The $\overline{S\emptyset}$ signal output at TP2 is applied to the second demodulator bridge consisting of diodes CR9 through CR14 and constant-current-source transistors Q21 and Q22.

The 0° and 180° clock outputs at TP4 and TP5 alternately switch the polarities of the two demodulator bridges thereby demodulating the SØ input to the bridges at a clock rate. The demodulated NRZ from the junction of diodes CR4, CR7, CR10, and CR13 is applied through the normally open contacts of K1 (SØ mode) to emitter-follower Q11-Q14. The NRZ output from emitter-follower Q11-Q14 is balanced around ground by R43 and applied to pin 21 of the card.

4.3.3 Bit-Rate Filter (Ref. Figure 4-6)

The bit-rate-filter printed-wiring board (assembly no. 6487) is located in the card-file assembly (A2) card slot 3 (J3). Discrete components are used for all printed-wiring-board circuitry. The main function of the bit-rate-filter circuitry is to remove the noise content of the serial PCM input.

Serial PCM data from the input amplifier is applied to pin 14 of the bit-rate filter. This signal is filtered by an RC filtering network. The filter network is composed of emitter-follower Q1-Q4 and resistor-capacitor combinations selected by relay contact closures. The relays energized are determined by the bit rate selected by bit-rate selection control. The selected resistor-capacitor values provide a variable filter having a 3-Db cutoff frequency at the bit rate. The filtered PCM output from emitter-follower Q1-Q4 is balanced around ground by R30 and applied to pin 16.

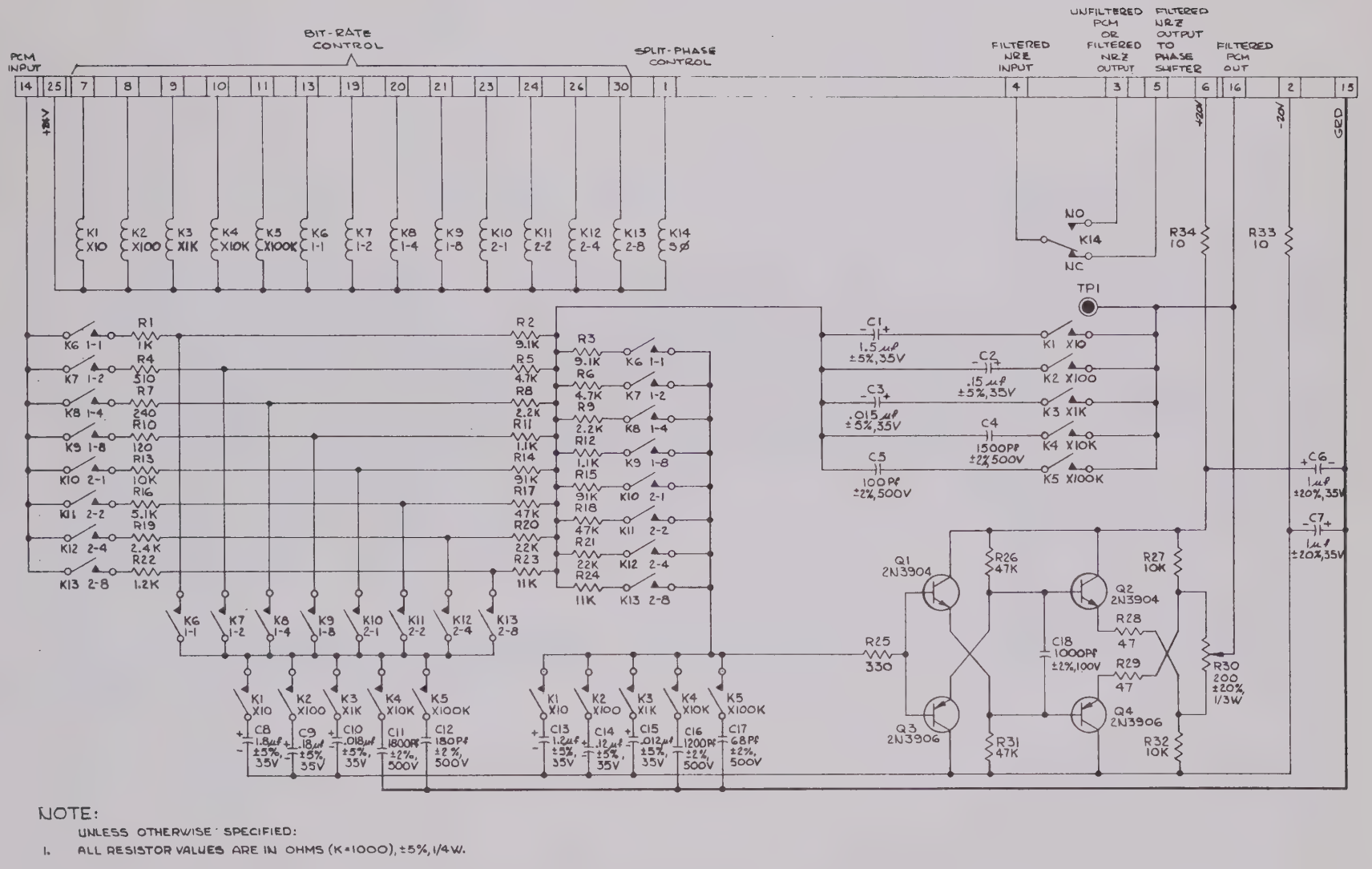


Figure 4-6. Bit-Rate Filter, (Sheet 1 of 2)

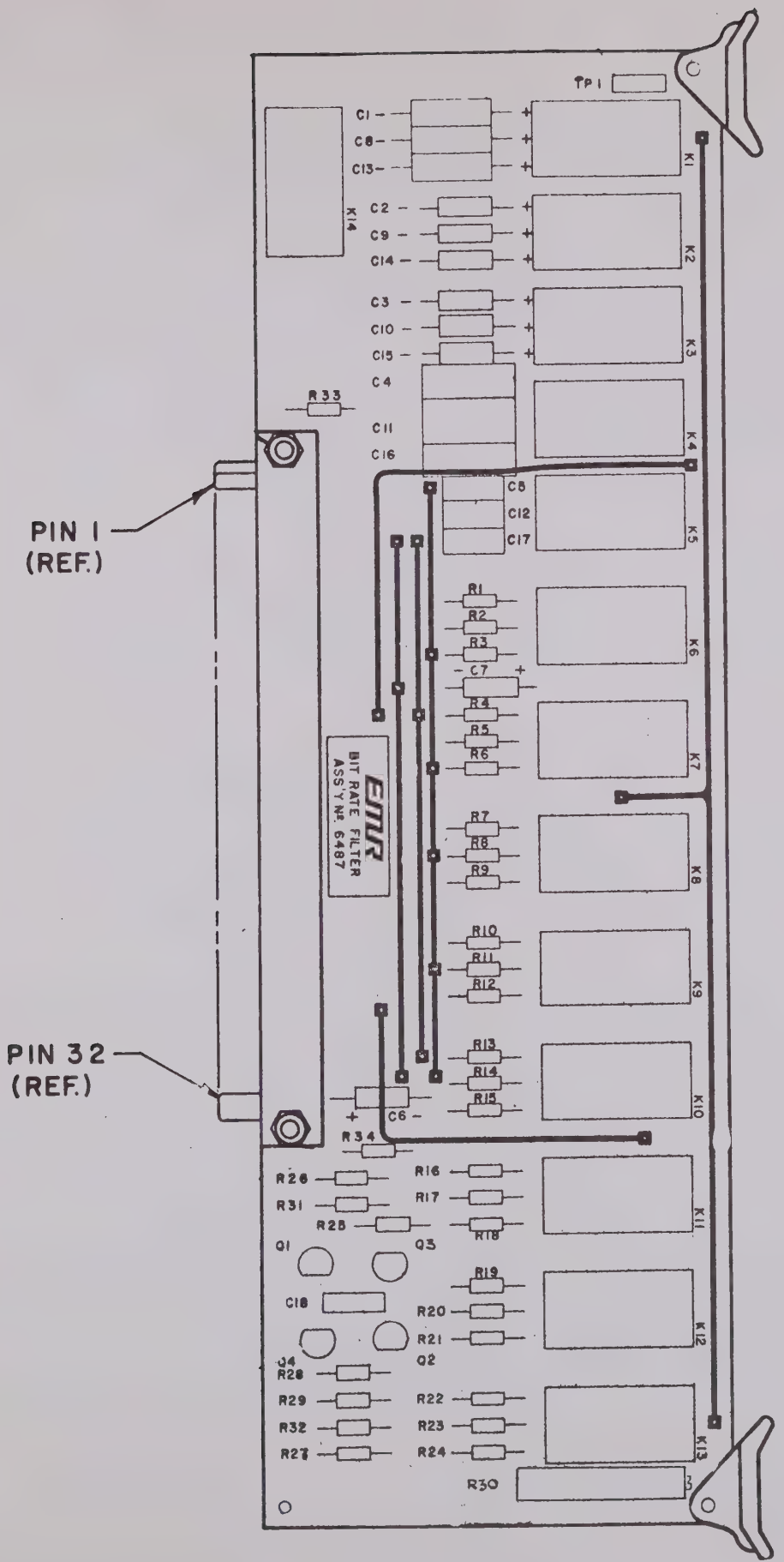


Figure 4-6. Bit-Rate Filter, (Sheet 2 of 2)

A square-sided input to the bit-rate filter circuitry produces a sinusoidal wave output which is centered about ground. Figure 4-7 illustrates typical input-output waveforms for the bit-rate filter.

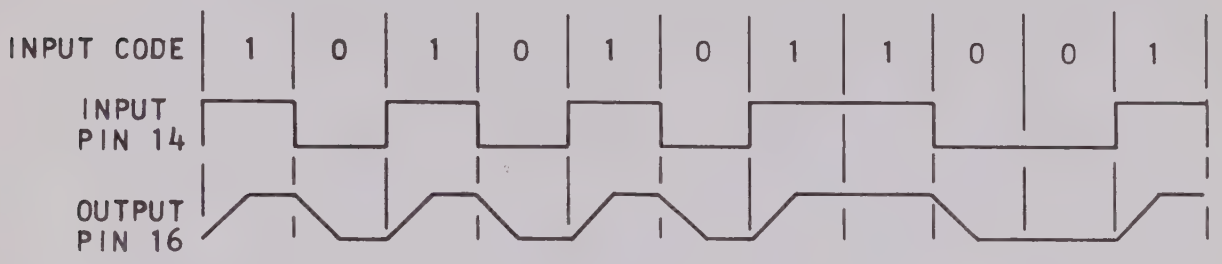


Figure 4-7. Typical Bit-Rate Filter, Input-Output Waveforms

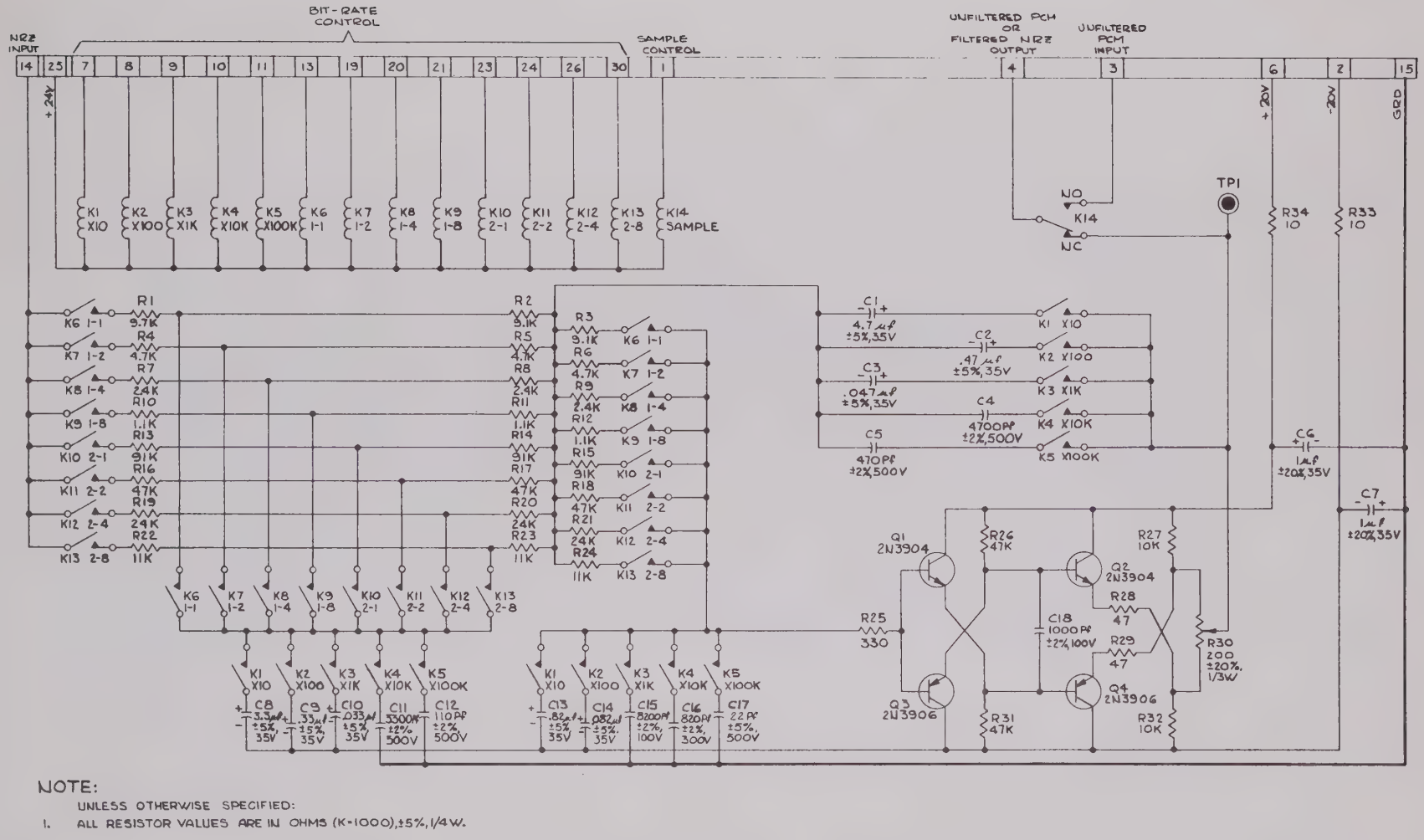
The output of the bit-rate filter is applied to the phase-shifter printed-wiring board but only used in the SØ mode. Voltage filters are provided for the +20V DC (R34, C6) and -20V DC (R33, C7).

4.3.4 Bit Rate/2 Filter (Ref. Figure 4-8)

The bit-rate/2 filter printed-wiring board (assembly no. 6489) is located in the card-file assembly (A2) card slot 5 (J5). Discrete components are used for all printed-wiring-board circuitry. The main function of the bit-rate/2 filter circuitry is to remove the noise content of the serial PCM input.

A serial NRZ input from the SØ-to-NRZ converter is applied to pin 14 of the bit-rate/2 filter. This signal is filtered by an RC filtering network. The filter network is composed of resistor-capacitor combinations selected by relay contact closures. The relays energized are related to the bit rate selected. The combination of bit-rate-selection control and the resistor-capacitor values selected provides a variable filter having a -3-Db cutoff at half the bit-rate frequency. The output of the RC filter network is applied to emitter-follower Q1-Q4. Emitter-follower Q1-Q4 provides a manually adjustable output (R30) to the normally closed contact of relay K14. The output at pin 4 of the bit-rate/2 filter is controlled by relay K14. Relay K14 is energized when the Model 2721 is operating in the sample detector mode. For all operating modes except sample, the output of the bit-rate/2 filter printed-wiring board is the output of emitter-follower Q1-Q4. In the sample mode of operation, the PCM input at pin 3 from the input amplifier is connected through the normally open contacts of K14 to card pin 4. The output of the bit-rate/2 filter on pin 4 is applied to the phase-shifter printed-wiring board.

A square-sided input to the bit-rate/2 filter circuitry produces a sinsoidal wave output which is centered about ground by R30. Figure 4-9 illustrates typical input-output waveforms for the bit-rate/2 filter. Voltage filters are provided for the +20V DC (R34, C6) and -20V DC (R33, C7).



NOTE:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4W.

Figure 4-8. Bit-Rate/2 Filter, (Sheet 1 of 2)

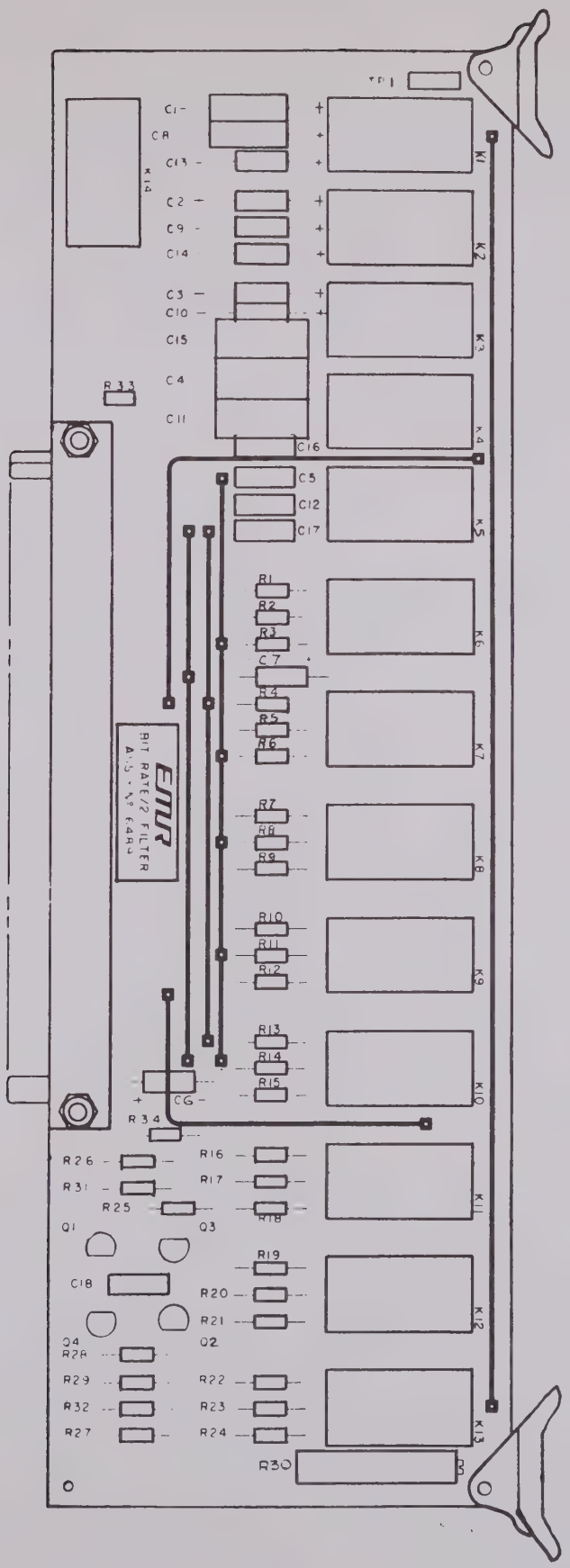


Figure 4-8. Bit-Rate/2 Filter, (Sheet 2 of 2)

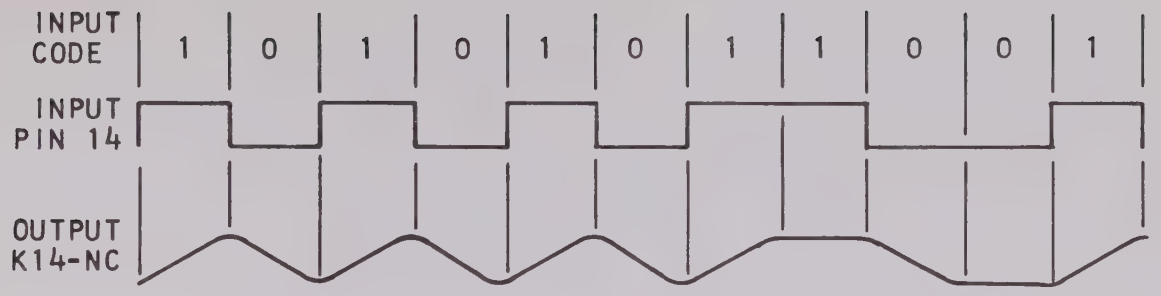


Figure 4-9. Typical Bit-Rate/2 Filter, Input-Output Waveforms

4.3.5 Reset Integrator (Ref. Figure 4-10)

The reset integrator printed-wiring board (assembly no. 6491) is located in the card-file assembly (A2) card slot 4 (J4). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The main function of the reset-integrator circuitry is to remove the noise content from the SØ-to-NRZ converter output.

A serial NRZ input from the SØ-to-NRZ converter is applied to pin 8 of the reset-integrator printed-wiring board. The signal is applied through a delay line to emitter-follower Q27-Q28. Delay line DL1 equalizes the signal-path delay for all detector modes. The delay line is bypassed in a SØ mode of operation by relay K1. The output of emitter-follower Q27-Q28 is integrated by an RC network. Resistor-capacitor component combinations for the RC network are selected by relay contact closures. The relays energized are determined by the selected bit rate. The integrated output from the RC network is simultaneously applied to emitter-follower Q3, Q4, Q14, Q15; emitter-follower Q5, Q6, Q16, Q17, and to reset switches Q23-Q26. Timing for the reset switches is derived from the clock input on pin 22. The reset switches alternately shunt the integrated signal inputs to the two emitter-followers to ground at the bit-rate frequency.

The clock input from the bit decision-code converter printed-wiring board, occurring at twice the bit rate, is divided by 2 by module Z1 on the reset-integrator printed-wiring board. Both polarities of the divided clock are applied to clock amplifiers Q1, Q12, and Q2, Q13. The clock-amplifier outputs drive the reset switches which are arranged in pairs. Reset switch Q23, Q24 shunts the integrated input to emitter-follower Q3, Q4, Q14, Q15 to ground at the bit-rate frequency. Reset switch Q25, Q26 shunts the integrated input to emitter-follower Q5, Q6, Q16, Q17 to ground at the bit-rate frequency. The outputs of the two emitter-follower circuits are balanced around ground by R19 and R21, respectively, and applied as inputs to summing amplifier Q7,Q18. The input to the summing amplifier is balanced about ground by R22. The summed serial data is buffered by emitter-follower Q8, Q9, Q19, Q20 and applied to the output amplifier (Q10, Q11, Q21, Q22). The output amplifier output is applied to the normally open

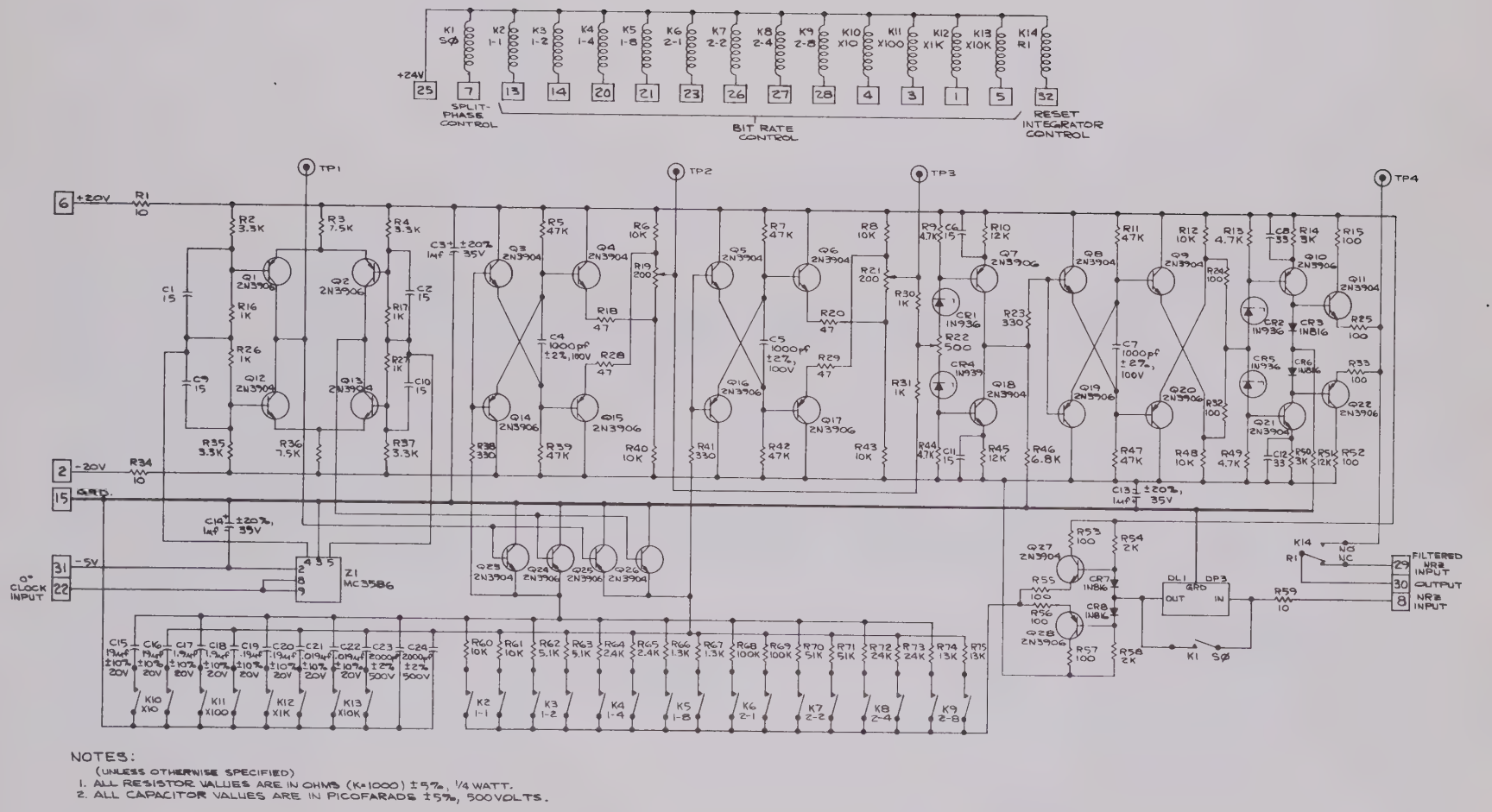


Figure 4-10. Reset Integrator, (Sheet 1 of 2)

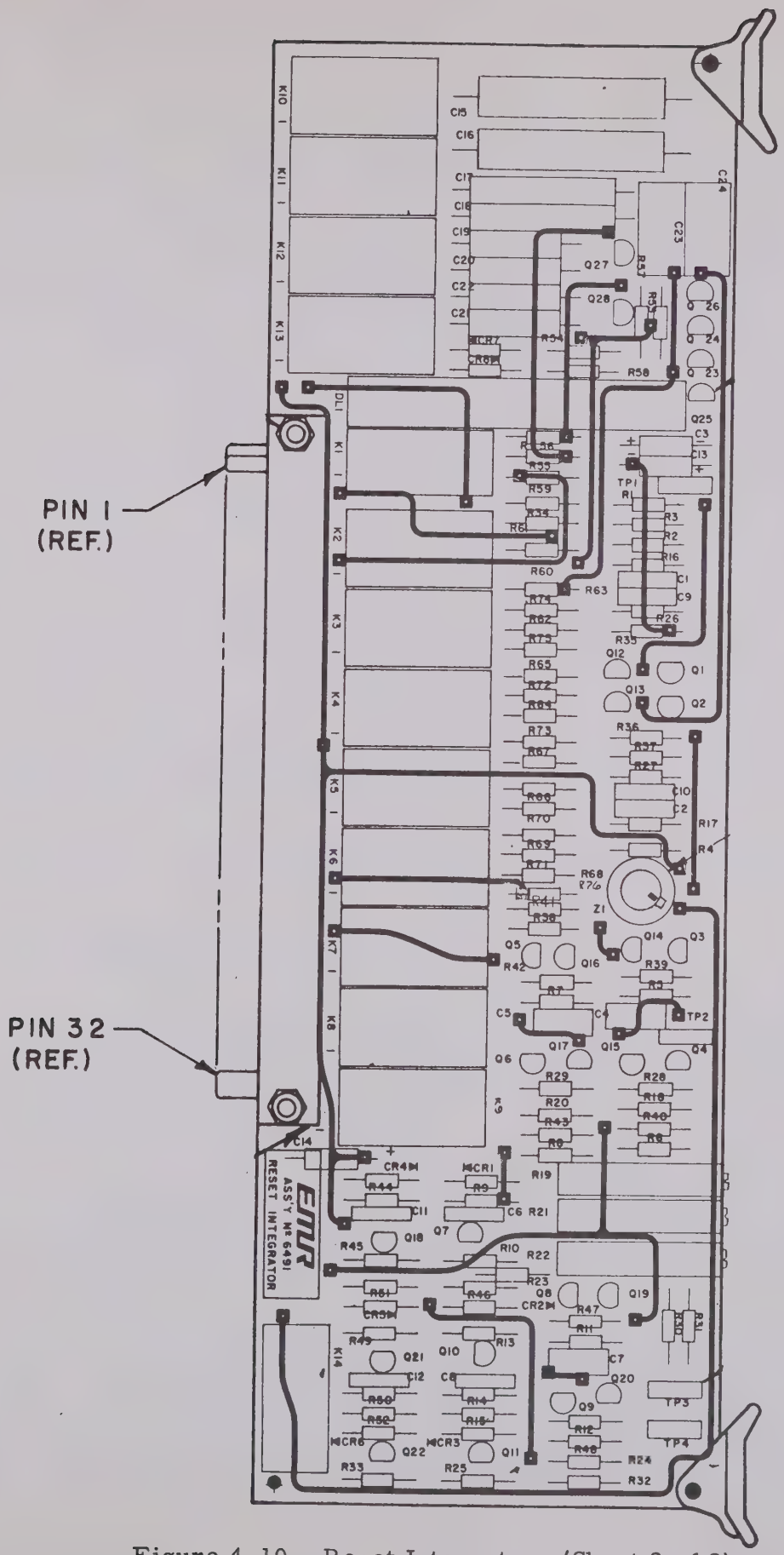


Figure 4-10. Reset Integrator, (Sheet 2 of 2)

contact of relay K14. For all modes of operation except reset integrator and sample, the bit-rate/2 filter output applied at pin 29 is applied through the relay contacts to pin 30. In the reset-integrator mode of operation, relay K14 is energized and the output of the output amplifier is applied to pin 30.

A square-sided input to the reset integrator circuitry produces a triangular wave output which is centered about ground. Figure 4-11 illustrates typical input-output waveforms for the reset integrator. Voltage filters are provided for the +20V DC (R1, C3), −20V DC (R34, C13), and −5V DC (C14).

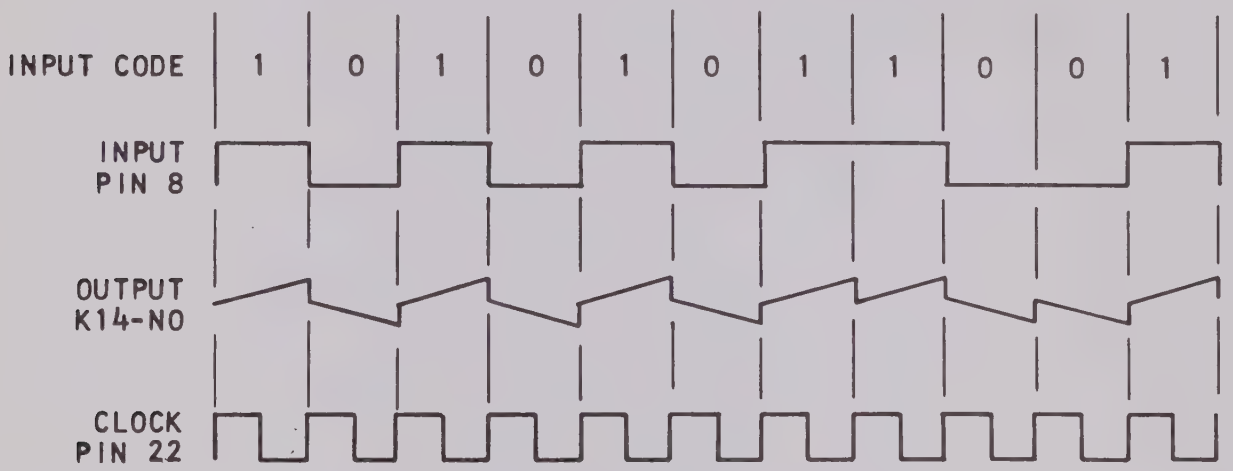


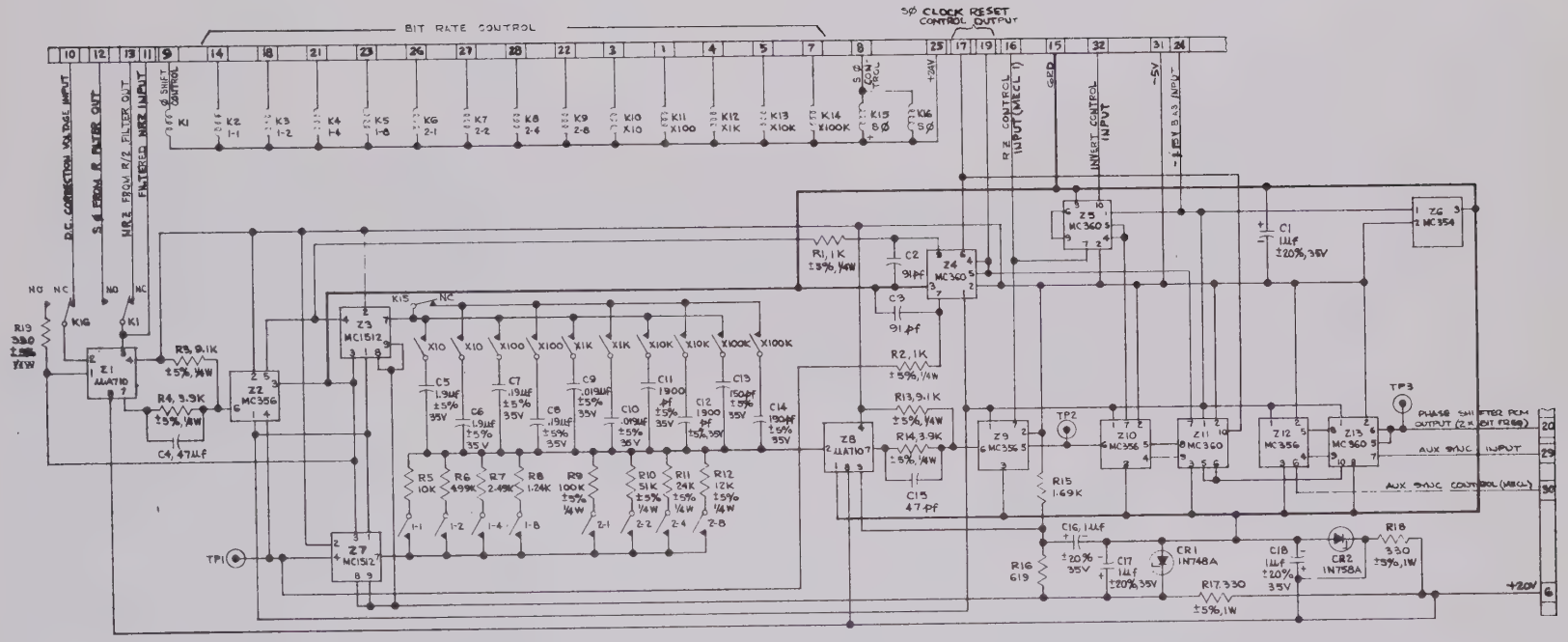
Figure 4-11. Typical Reset Integrator, Input-Output Waveforms

4.3.6 Phase Shifter (Ref. Figure 4-12)

The phase-shifter printed-wiring board (assembly no. 6493) is located in the card-file subassembly (A2) card slot 6 (J6). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The phase-shifter circuitry restores the filtered serial PCM to DC levels and provides an output serial PCM signal at twice the bit rate.

Input selection for the phase-shifter circuitry is shown in Figure 4-13. The inputs to control card no. 3, shown in Figure 4-13, refers to front-panel nomenclature of the programmable INPUT and DETECTOR modes. Programming the associated control lines will energize the relays.

The input to the phase-shifter circuitry is a sinusoidal-wave output from the filtering circuits. The sinusoidal wave is squared by differential comparator circuit Z1. The squared serial PCM is level-shifted and applied to module Z2 which provides serial PCM data-pulse outputs of both polarities. The outputs from Z2 are applied simultaneously to the phase-shifter network (Z3, Z7, and their associated resistor-capacitor phase-shifting network) and level shifter Z4.



NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTOR VALUES ARE IN OHMS (K=1000) ±1%, 1/8W

Figure 4-12. Phase Shifter, (Sheet 1 of 2)

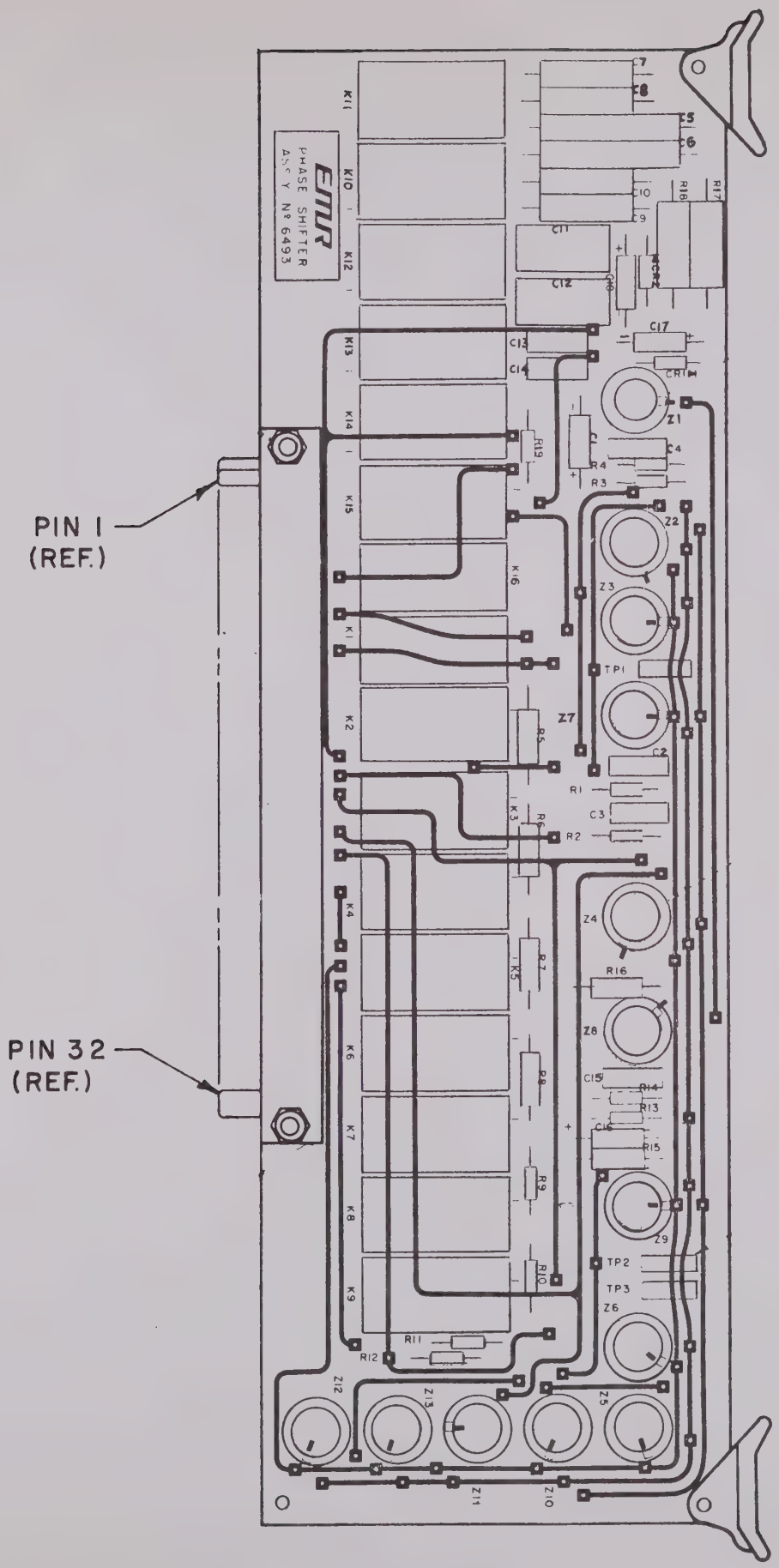


Figure 4-12. Phase Shifter, (Sheet 2 of 2)

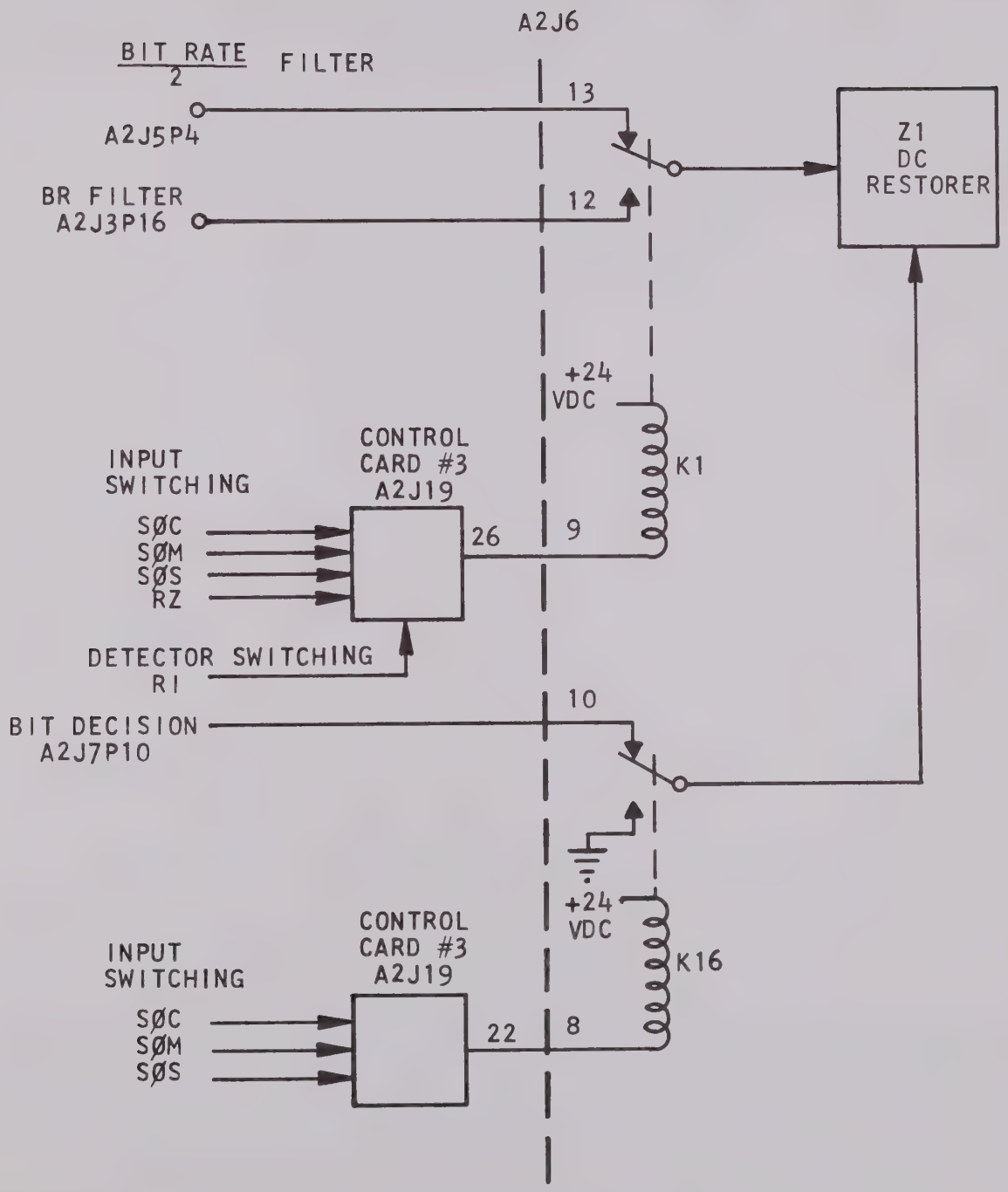


Figure 4-13. Input Selection Phase Shifter

The phase-shifting network utilizes an RC network to phase shift the serial PCM data from Z2 by 90°. The components comprising the resistor-capacitor network are selected by relay contact closures. The relays used for this selection are programmed by the associated control lines. The output of the phase-shifting network is applied to limiters Z8 and Z9 establishing DC bit levels. The serial PCM data output from limiter Z9 is applied to level shifter Z10. The output from level shifter Z10 is serial PCM data of both polarities at the same bit levels as the output of level shifter Z4, but delayed 90°.

The output from level shifter Z4 and the 90° phase shifted output from Z10 are summed by the phase-detector circuits (Z5, Z6, and Z11 through Z13). In phase detecting the level-shifter outputs, the phase-detector circuits produce a serial PCM data train which has one complete cycle output for each bit-transition of the input. The output of the phase-shifter circuitry is applied to the loop-resistor circuits and loss-of-lock circuits through pin 20 of the phase-shifter printed-wiring board. Figure 4-14 shows typical waveforms of the phase-shifter circuitry.

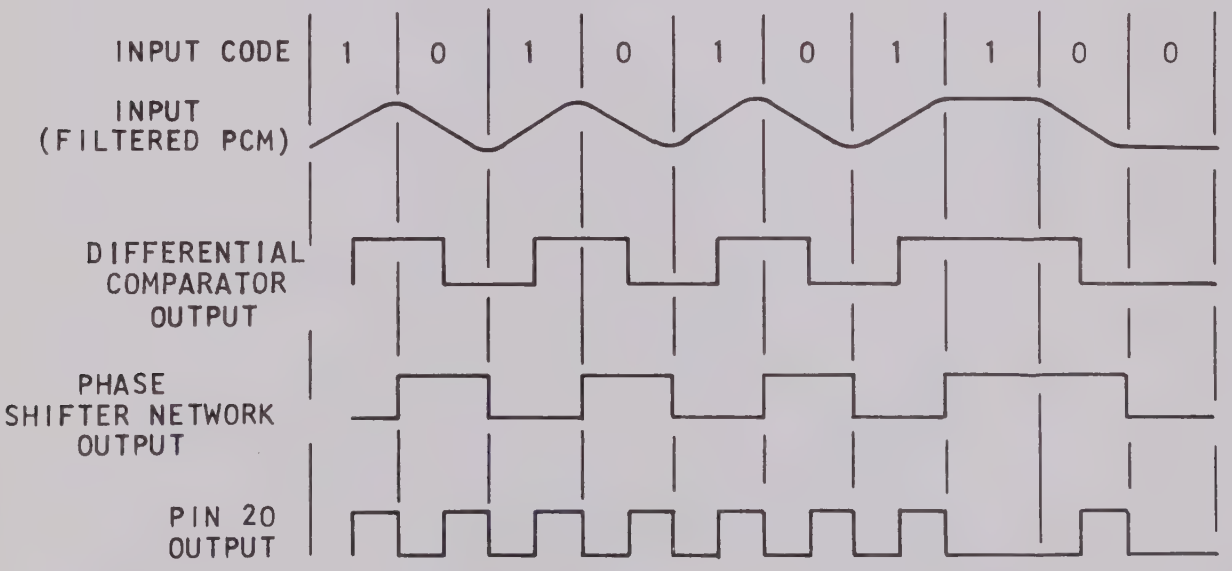
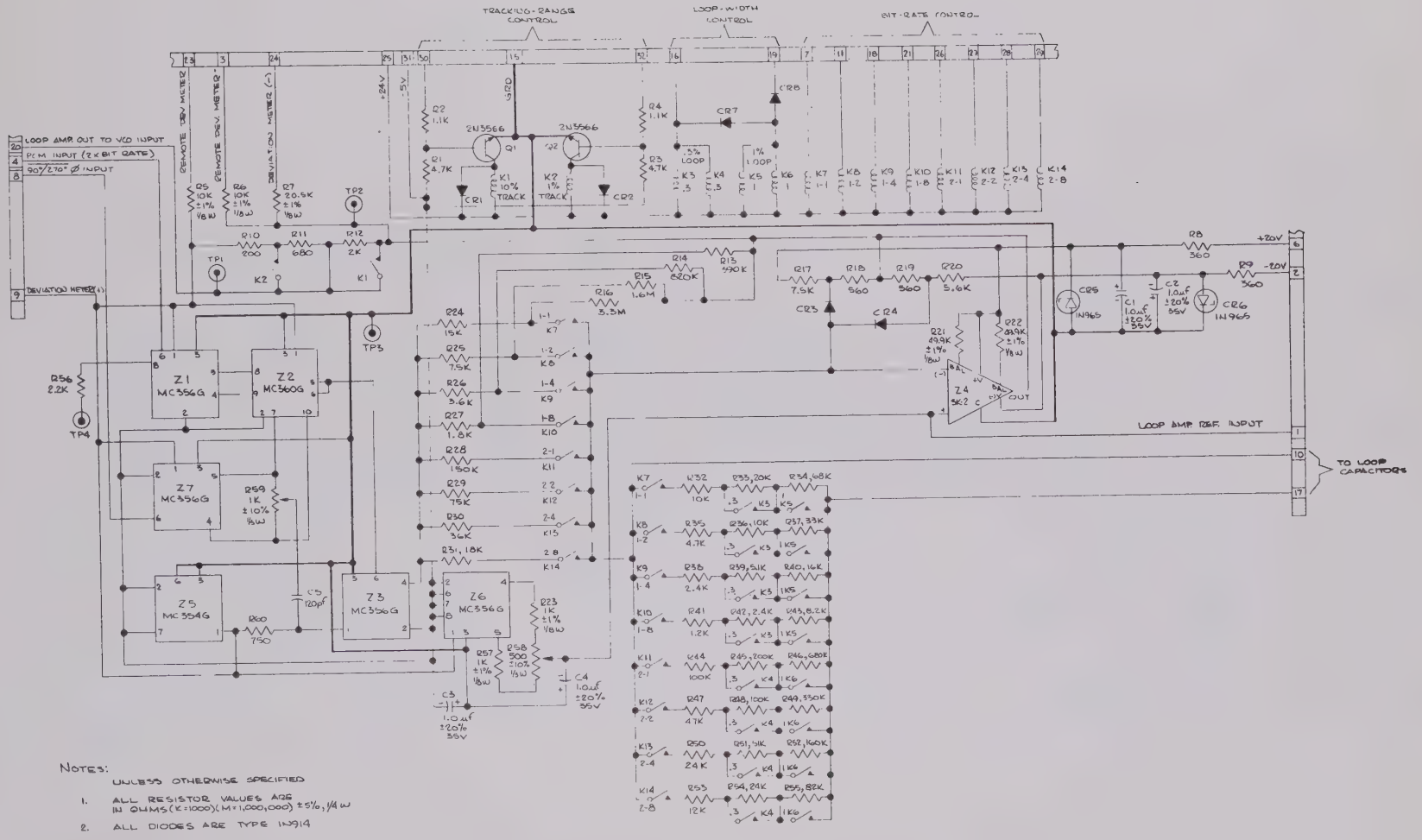


Figure 4-14. Phase Shifter, Typical Waveforms

Zener diode CR1, capacitor C17, and resistor R17 provide +5V DC for modules Z3 and Z7. Zener diode CR2, capacitor C18, and resistor R18 provide +10V DC for modules Z1 and Z8. Both reference voltages are derived from the +20V DC input to the phase-shifter printed-wiring board.

4.3.7 Loop Amplifier/Filter (Ref. Figures 15 and 16)

The loop amplifier/filter is composed of two printed-wiring boards: Loop resistor (Figure 4-15) and loop capacitor (Figure 4-16). The loop-resistor printed-wiring board (assembly no. 13160) is located in the card-file subassembly (A2)



NOTES:
UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000)(M=1,000,000) ±5%, 1/4 W
2. ALL DIODES ARE TYPE IN914

Figure 4-15. Loop-Resistor Card, (Sheet 1 of 2)

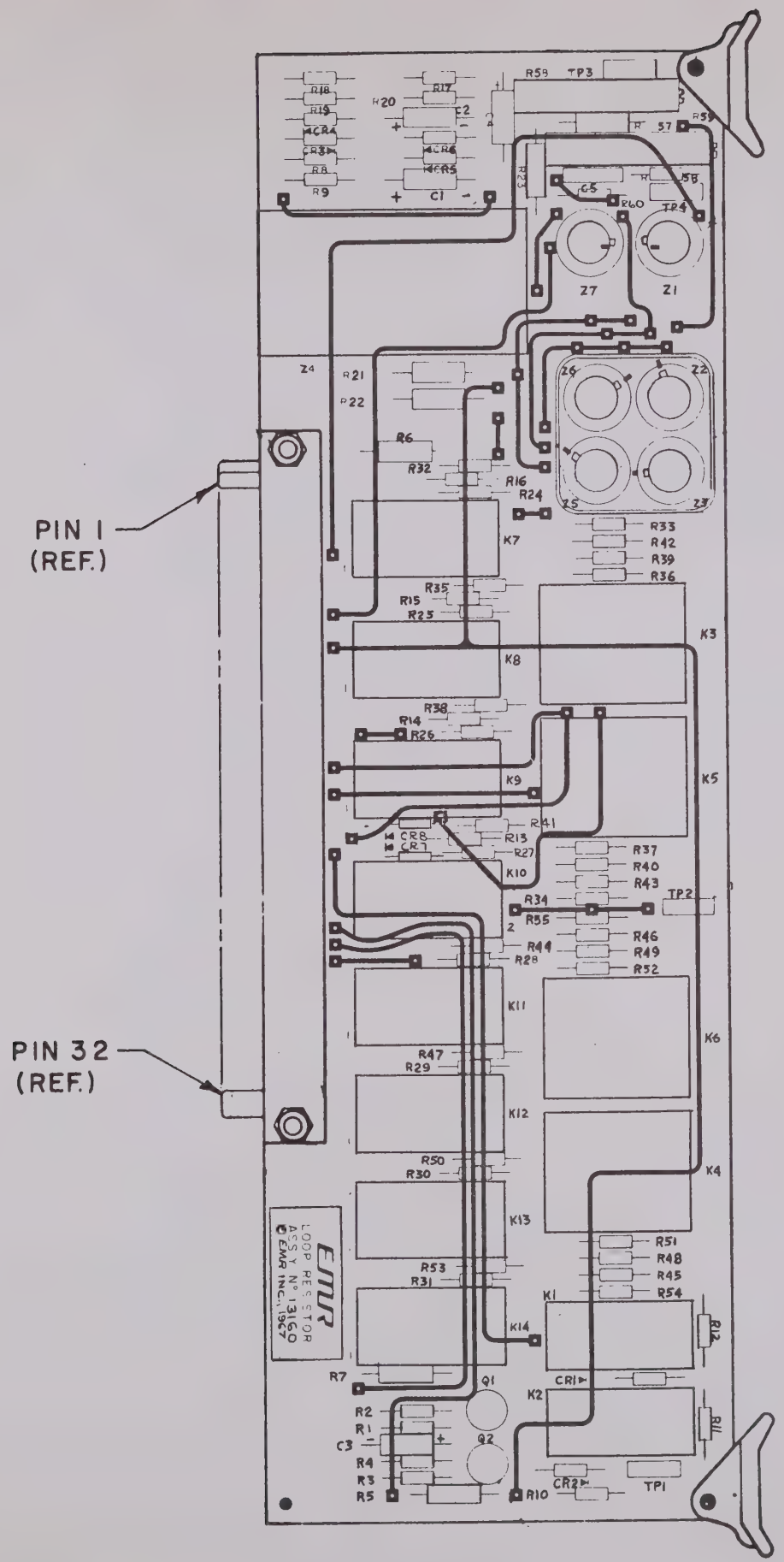
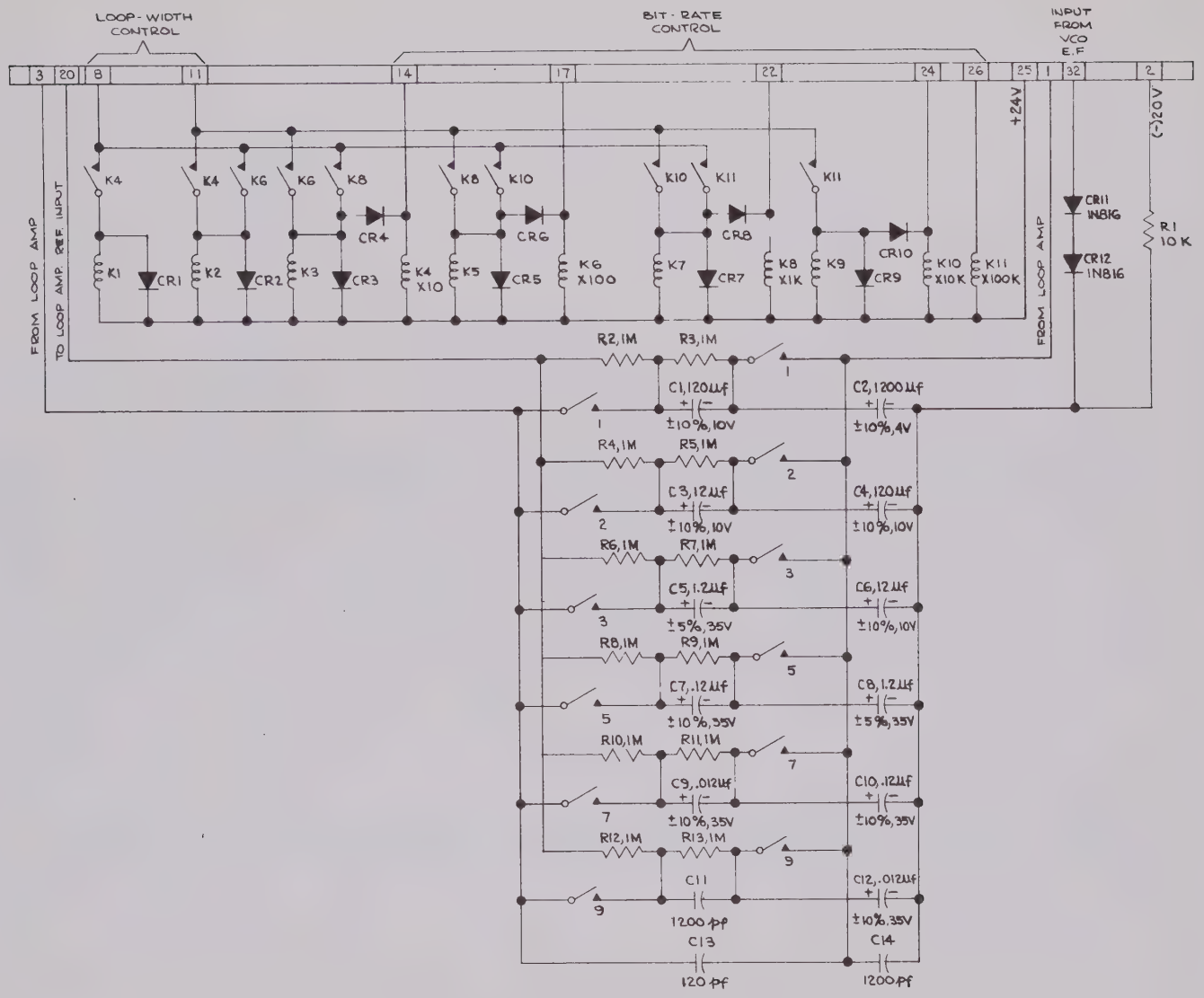


Figure 4-15. Loop-Resistor Card, (Sheet 2 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED
1: ALL RESISTOR VALUES ARE IN OHMS (K=1000), (M=1,000,000) ±5%, 1/4W
2: ALL DIODES ARE TYPE IN914 EXCEPT AS NOTED

Figure 4-16. Loop Capacitor Card, (Sheet 1 of 2)

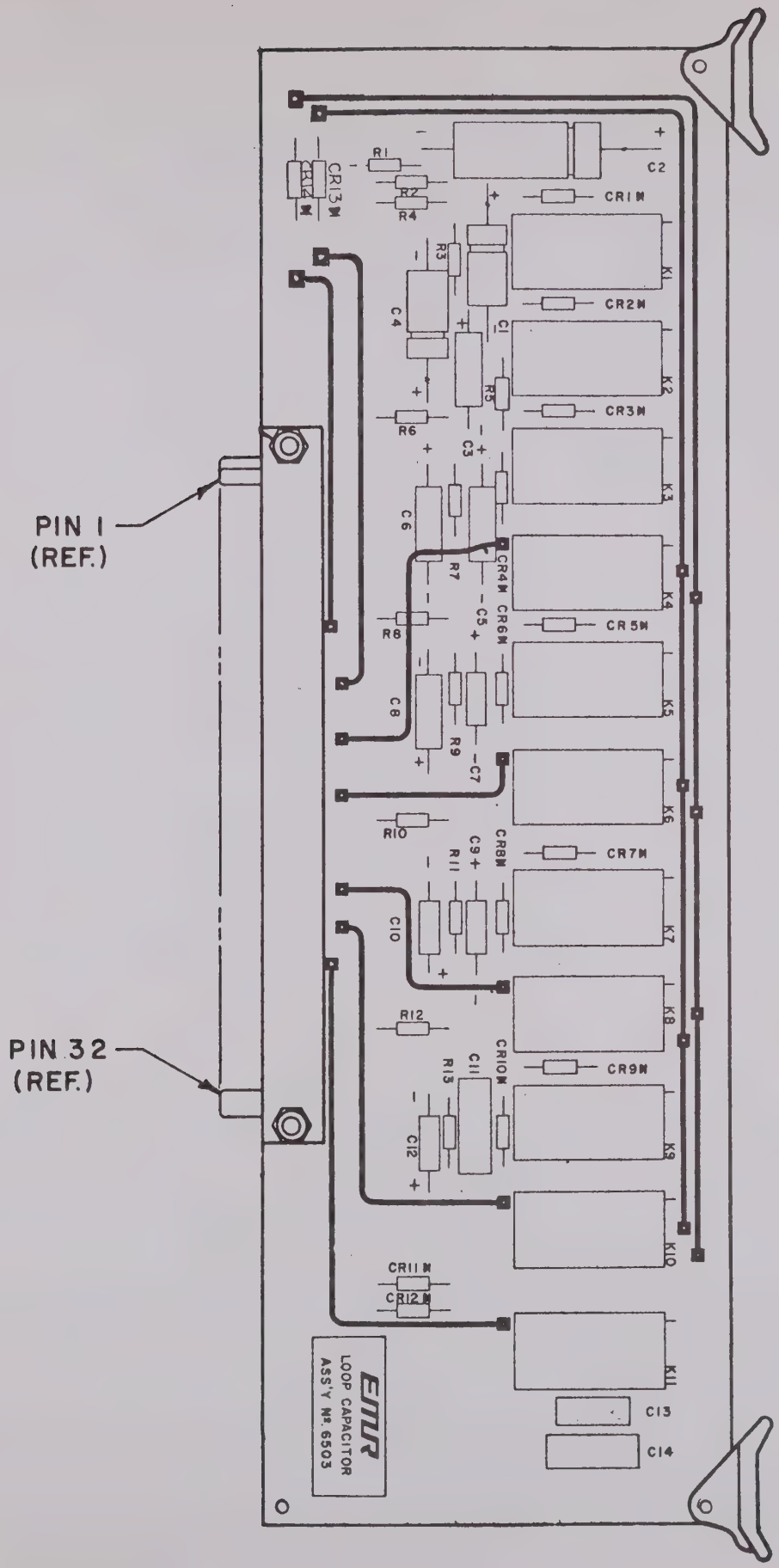


Figure 4-16. Loop Capacitor Card, (Sheet 2 of 2)

card slot 10 (J10). The loop-capacitor printed-wiring board (assembly no. 6503) is located in the card-file subassembly (A2) card slot 11 (J11). Integrated circuits and discrete components are used for all loop-resistor printed-wiring circuitry and discrete components are used for all loop-capacitor printed-wiring-board circuitry. The combined loop-resistor and loop-capacitor circuitry accepts the serial PCM data from the phase-shifter circuitry and acts as a loop amplifier/filter. The loop amplifier/filter input is summed with the internal Model 2721 bit-rate signals to produce a serial PCM data train which has a 50% bit-rate duty cycle regardless of the input code. A 50% bit-rate duty cycle is the null condition in the phase-lock loop achieved when the Model 2721 internal bit-rate is equal to the serial PCM data bit-rate input to the Model 2721. The serial PCM data input to the loop amplifier/filter circuitry is filtered by an RC network and any deviation from a 50% duty cycle applies a DC correction voltage to the VCO.

The output of the phase-shifter circuitry is applied to pin 4 of the loop-resistor printed-wiring board. This signal is applied as one input to the phase-detector circuitry (Z1, Z2, Z3, and Z7). Ninety-degree clock pulses are applied to pin 8 of the loop-resistor printed-wiring board and are used as another input to the phase-detector circuitry. Both inputs to the phase-detector circuitry are applied to two gates which provide both polarities of each signal. These signals are applied to summing-gate Z2 where the serial PCM data input is summed with the clock pulses to produce a serial PCM wavetrain having a 50% duty cycle. The relationship of the incoming serial PCM data at pin 4 of the loop-resistor printed-wiring board, the 90° clock pulses applied to pin 8, and the output of summing-gate Z2 on the loop-resistor printed-wiring board is shown in Figure 4-17. The summed output of Z2 is a square-sided serial PCM wavetrain with a 50% duty cycle regardless of the input code. A duty cycle of 50% is maintained when the Model 2721 is in bit synchronization with the serial PCM data input.

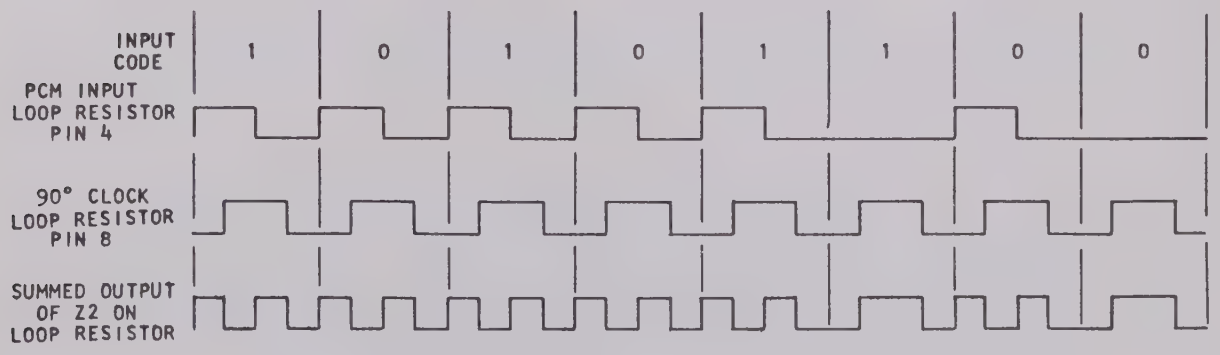


Figure 4-17. Loop Amplifier/Filter Timing Diagram

The summed output of Z2 is applied as one input to buffer Z3. The output from loop-compensation circuit Z5 is applied as the reference input to buffer Z3. Loop-compensation circuit Z5 is manually adjustable by R59 and compensates for imbalance in the clock pulses at high frequencies. The output of buffer Z3 is applied to an RC filtering network.

The RC filter network is comprised of components on the loop-resistor and loop-capacitor printed-wiring boards. The choice of resistors and capacitors to be used in the filter network determine VCO bit rate and loop width. Selection of the appropriate resistors and capacitors used to establish VCO bit rate and loop width is made by relay contact closures. The relays are controlled by bit-rate programming. The output of phase-detector buffer Z3 is filtered by the selected resistor-capacitor combinations and loop amplifier Z4.

Loop amplifier Z4 is balanced to a null condition by loop balance circuit Z6. Loop amplifier Z4 provides a correction voltage to the VCO which will cause the VCO and the divider circuits to provide a bit-rate frequency equal to the selected bit-rate frequency. Changes in the duty cycle of phase detector buffer Z3, after filtering by the RC filter network, will cause loop amplifier Z4 to deviate from a null condition. The output of loop amplifier Z4 is applied to a resistor divider network (R10, R11, and R12). Portions of the resistor divider network are shunted by relay contact closures to change the limits of the deviation voltage available through the resistor divider network. The relays controlling this function are K1 and K2.

A DC potential is applied to pin 30 or pin 32 of the loop-resistor printed-wiring board. The DC potential at pin 30 is determined by the programmed TRACKING range. The DC potential controls relay driver circuits Q1, Q2 and associated relays K1 and K2. The output of the resistor divider network (R10, R11, and R12) is the output of the loop amplifier/filter circuits and is applied to pin 20 of the loop-resistor printed-wiring board.

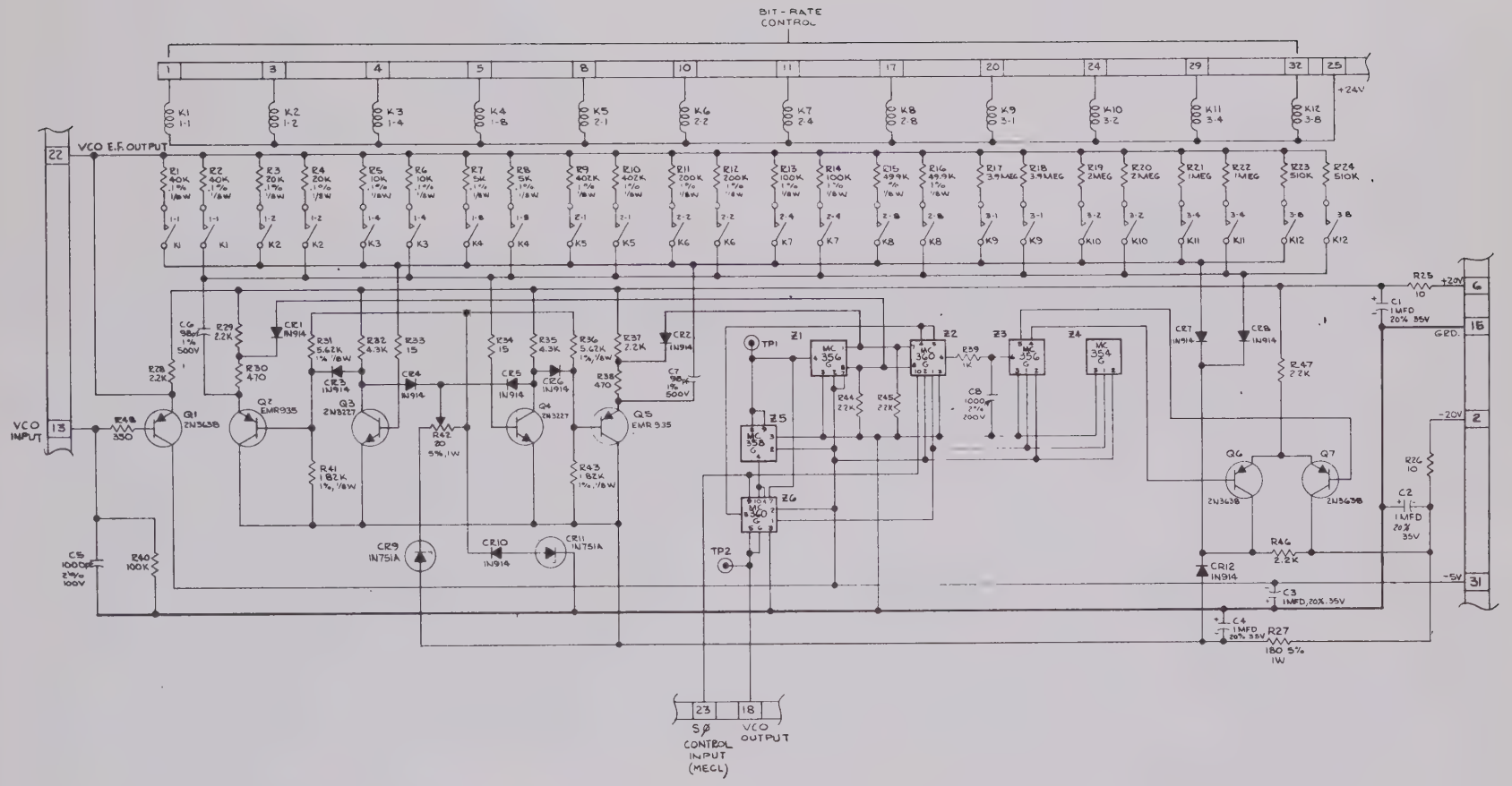
The output of loop amplifier Z4 is also applied to pin 24 of the loop resistor printed-wiring board through series-limiting resistor R7. The output on pin 24 is used by the front-panel DEVIATION meter as a visual indication of the correction voltage being applied to the VCO circuits.

Zener diode CR5, resistor R8, and capacitor C1 provide +15V DC for module Z4. Zener diode CR6, resistor R9, and capacitor C2 provide −15V DC for module Z4.

4.3.8 Voltage-Controlled Oscillator (Ref. Figure 4-18)

The voltage-controlled oscillator (VCO) printed-wiring board (assembly no. 13215) is located in the card-file subassembly (A2) card slot 13 (J13). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The VCO circuitry comprises a variable oscillator controllable by bit-rate programming. The oscillator output is applied to the divider circuits which provide the internal clock pulses and bit-synchronized timing signals.

The RC time constant of the oscillator (Q2 through Q5) has a fixed capacitance and variable resistance. The variable resistance is controlled by relay contact closures. Associated relays are controlled by bit-rate programming. Variations



NOTE:
(UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTOR VALUES ARE IN OHMS (K=1000) ±5%, 1/4 WATT.

Figure 4-18. Voltage Controlled Oscillator (VCO) Card, (Sheet 1 of 2)

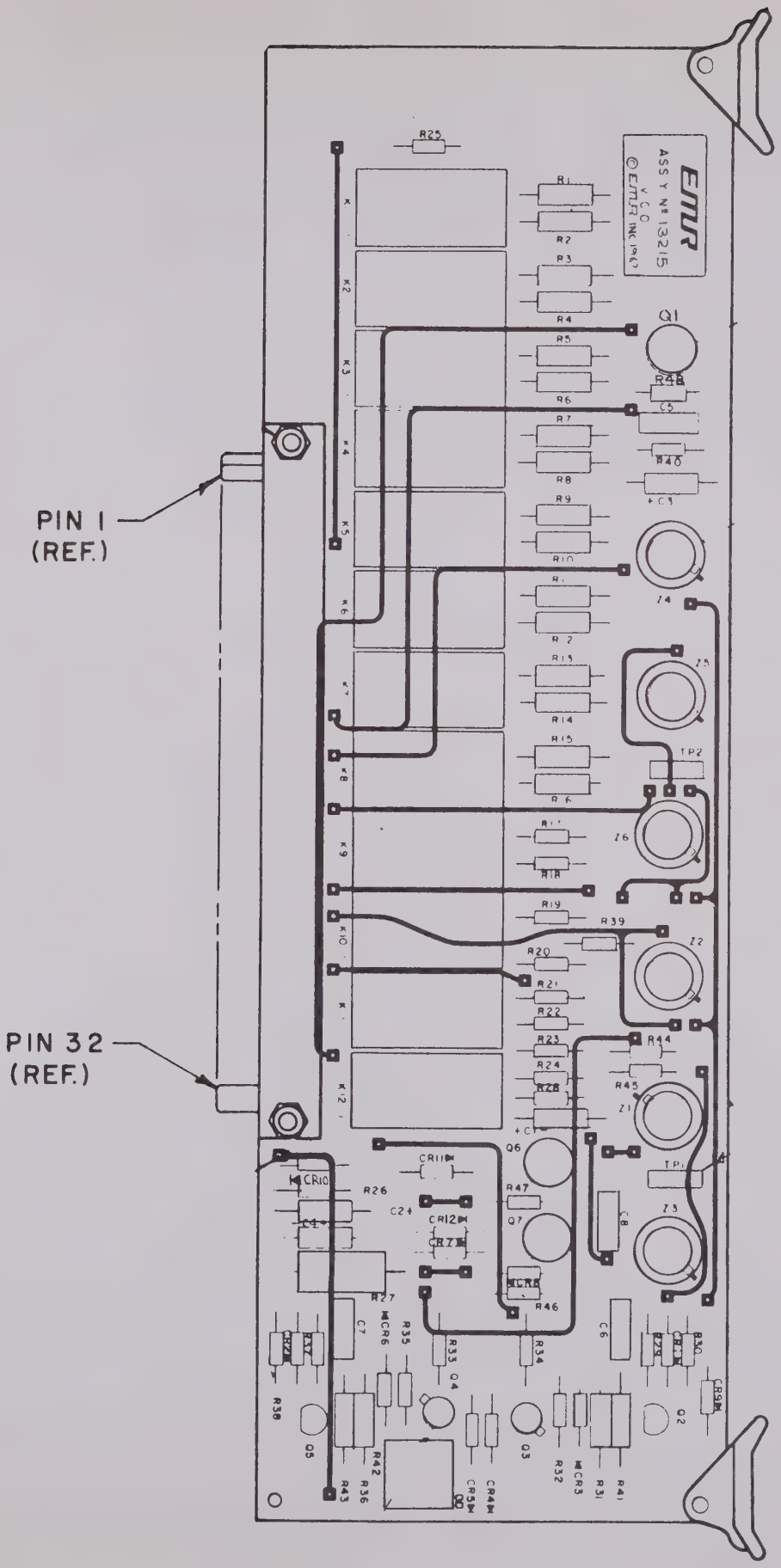


Figure 4-18. Voltage Controlled Oscillator (VCO) Card, (Sheet 2 of 2)

of the basic oscillator frequency are caused by the correction voltage applied at pin 13 of the VCO printed-wiring board. The correction voltage is buffered by emitter-follower Q1 and applied to the resistor timing network. The correction voltage allows the VCO circuits to achieve and maintain bit synchronization with the serial PCM input. A self-starting circuit (Q6, Q7) forces the oscillator (Q2-Q5) to maintain oscillation. The oscillator output frequency is manually adjustable by R42 over a range of approximately one percent. The oscillator output is applied to squaring circuits Z1, Z2, Z5 and Z6.

For all operating modes except SØ, the squaring circuits level shift, square, and divide the oscillator frequency by two. In a SØ mode, the oscillator frequency is level shifted, squared, and applied directly to pin 18 of the VCO printed-wiring board without division. A control level is applied to pin 23 of the VCO printed-wiring board to indicate whether division of the oscillator frequency is required by the VCO circuits.

A voltage-divider network consisting of resistor R27, zener diode CR9, potentiometer R42, temperature-compensating diode CR10, and zener diode CR11 provides −10V DC and −5V DC outputs for VCO operation. The -10V DC output is filtered by C4.

4.3.9 Divider (Ref. Figure 4-19)

The divider printed-wiring board (assembly no. 6505) is located in the card-file subassembly (A2) card slot 12 (J12). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The divider circuits divide the output of the voltage-controlled oscillator.

The divider circuits on the divider printed-wiring board are arranged in four groups. Each group serially divides the frequency by 10. The VCO output (pin 9 of the divider printed-wiring board) is applied to divider group no. 1 (Z8, Z12, Z16, Z20). The output of divider group no. 1 is the input frequency (pin 9 of the divider printed-wiring board) divided by 10 and is applied simultaneously to divider group no. 2 (Z9, Z13, Z17, Z21) and gate Z4. Each divider group operates in a similar manner, dividing the input to the particular divider group by 10 and applying the output to the next divider group and a gating network. All divider groups are active at all times and selection of the frequency to be used as the divider printed-wiring-board output is accomplished in the gates.

Gates Z4, Z5, and Z6 are used for the selection of the divider printed-wiring-board output. Each gate receives a frequency input from a divider group and a control signal. The control signal is received from the multiplier section of the bit-rate programming and determines which of the gates will be allowed to drive divider-output circuits Z1-Z3.

Divider-output circuits Z1-Z3 receive an input from the selected gate and provide three outputs: Clock pulses (pin 13 of the divider printed-wiring board) to

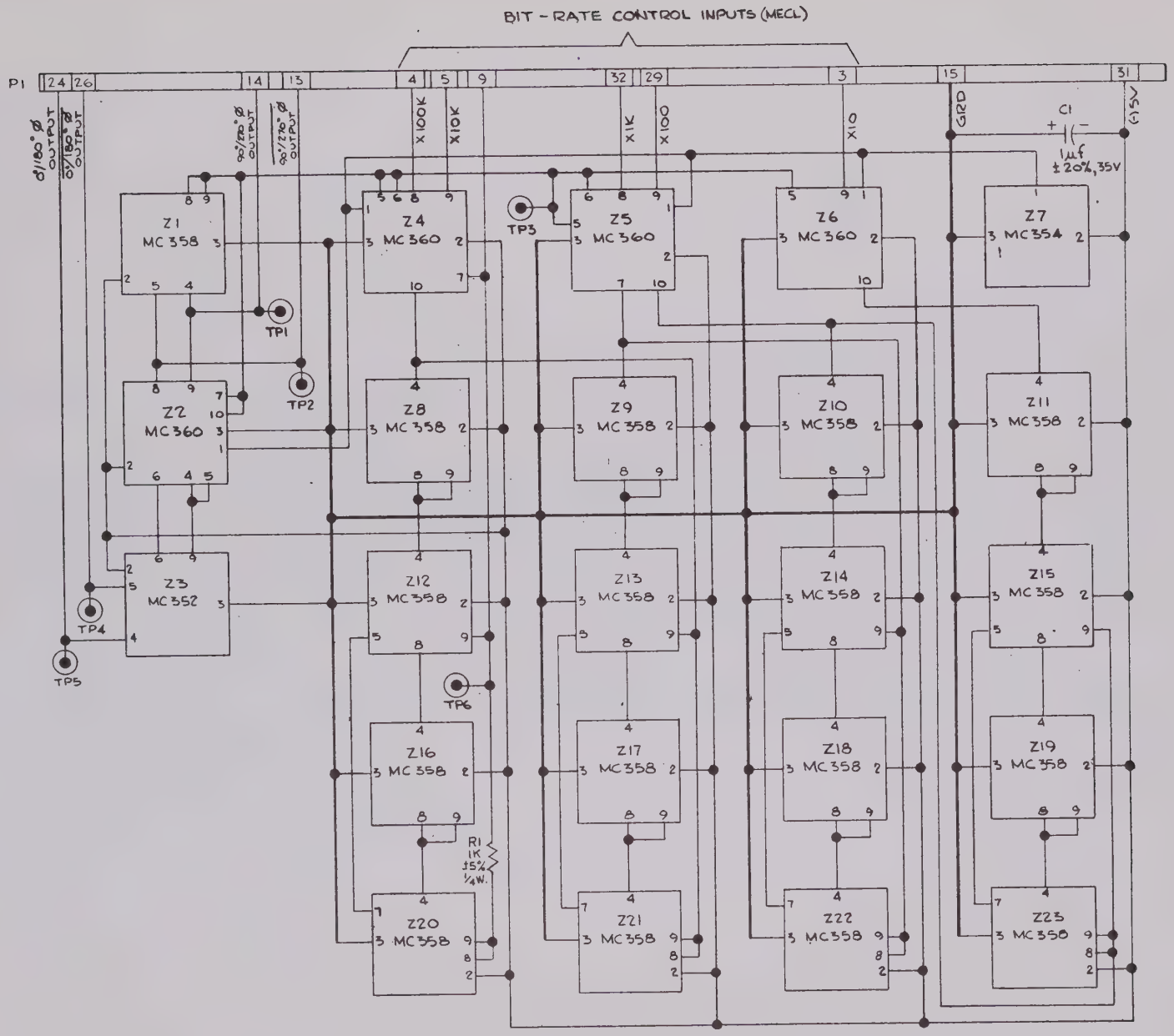


Figure 4-19. Divider Card, (Sheet 1 of 2)

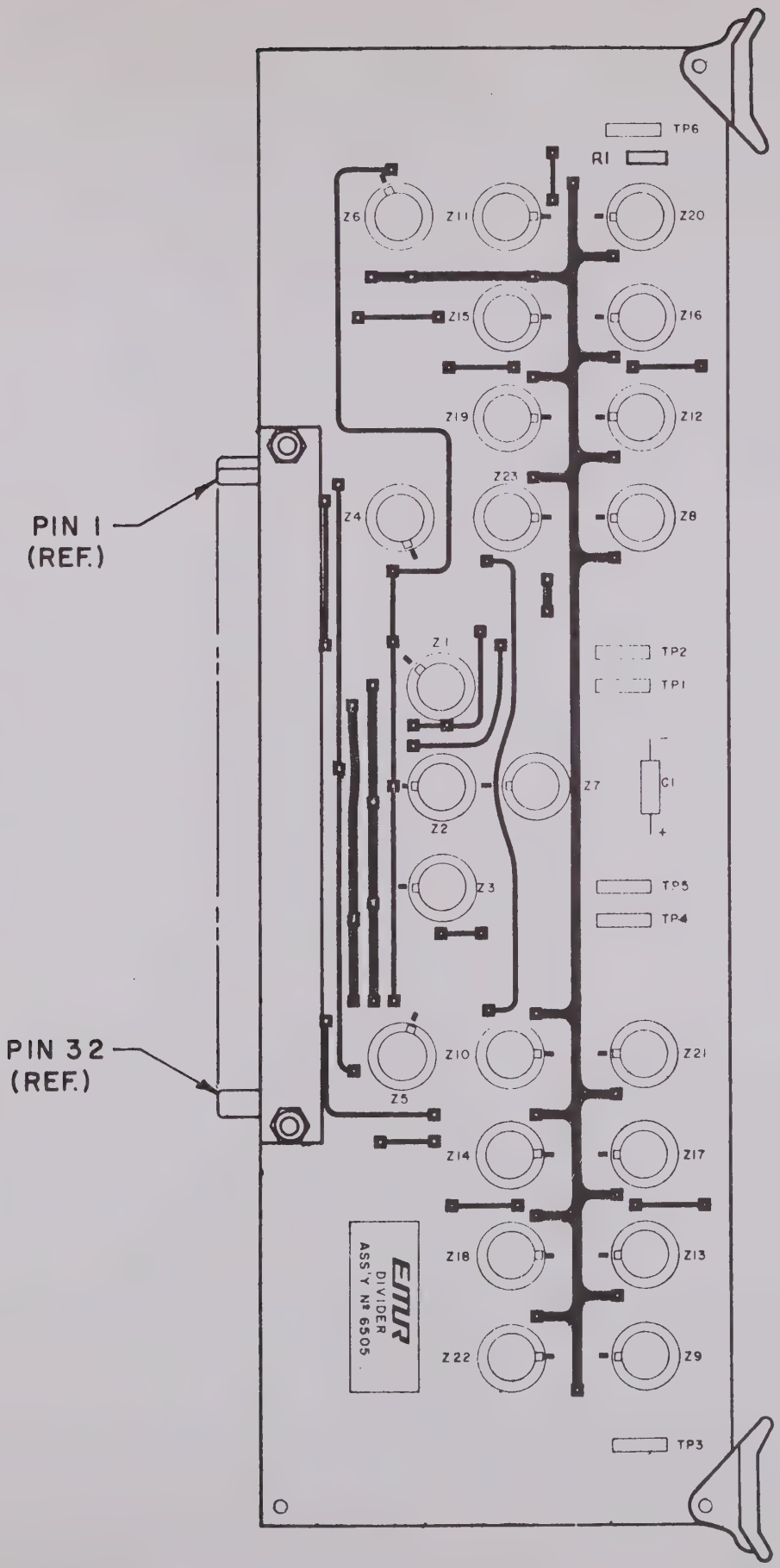


Figure 4-19. Divider Card, (Sheet 2 of 2)

be used in the loop amplifier/filter and split-phase clock reset circuitry and both polarities of clock pulses (pins 24 and 26 of the divider printed-wiring board) to be used in the loss-lock and counter circuits.

Bias driver Z7 provides the −1.15V DC bias level for the divider gating and output circuits. Voltage filtering for the −5V DC is provided by capacitor C1.

4.3.10 Split-Phase Clock Reset (Ref. Figure 4-20)

The split-phase clock reset printed-wiring board (assembly no. 14925) is located in the card-file subassembly (A2) card slot 14 (J14). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The split-phase clock reset circuitry provides bit-synchronized timing signals and includes special circuits required for the timing of the split-phase-to-NRZ converter circuitry.

A serial PCM signal, of both polarities, from the phase-shifter circuitry is applied to pins 3 and 5 of the split-phase clock reset printed-wiring board. Clock pulses from the divider circuitry are applied to pin 7 through driver Z30 of the split-phase clock reset printed-wiring board. Using the serial PCM signal (pins 3 and 5) and the clock pulses (pin 7), bit-decision circuit Z1-Z3 analyzes bit transitions of the incoming serial PCM with relation to the clock pulses. Bit-decision circuit Z1-Z3 is used only in the split-phase mode of operation. Split-phase formats require a transition of the serial PCM data at mid-bit time. Whether a bit transition occurs at the start of a bit time depends on the data content of the serial PCM. The bit-decision circuit, Z1-Z3, senses the serial PCM bit transitions and supplies one input to up-down counter control circuit Z4, Z5. Clock pulses from split-phase clock generator circuit Z19-Z21 gate the bit-decision circuit Z1-Z3 output in up-down counter control circuit Z4, Z5. Up-down counter control circuit Z4, Z5 instructs up-down counter circuit Z8-Z16 to countup or to count down.

Up-down counter circuit Z8-Z16 is clocked through driver Z31 by pulses (pin 8) from the divider circuits. As previously mentioned, SØ formats require a bit transition of serial PCM data at mid-bit time. Up-down counter circuit Z8-Z16 is programmed by up-down counter control circuit Z4, Z5 to count bit transitions of the serial PCM occurring at the start of a bit time and at mid-bit time. Since a transition always occurs at mid-bit time, up-down counter circuit Z8-Z16 counts down for mid-bit transitions and a zero count in the up-down counter is used to indicate synchronization.

Gate Z22 senses the zero state of up-down counter circuit Z8-Z16, Z34 and Z35, and gate Z6 is used to prevent up-down counter circuit Z8-Z16 from overflowing.

Bit-synchronizer clock pulses are provided by gates Z17 and Z18. The 0°, 90°, 180°, and 270° outputs are used internal to the Model 2721 for timing and are applied to the output amplifier circuits for distribution to external equipment.

The DC level inputs at pins 9 and 10 control the operation of modules Z23 and Z24. Modules Z23 and Z24 control the application of the clock-pulse inputs at

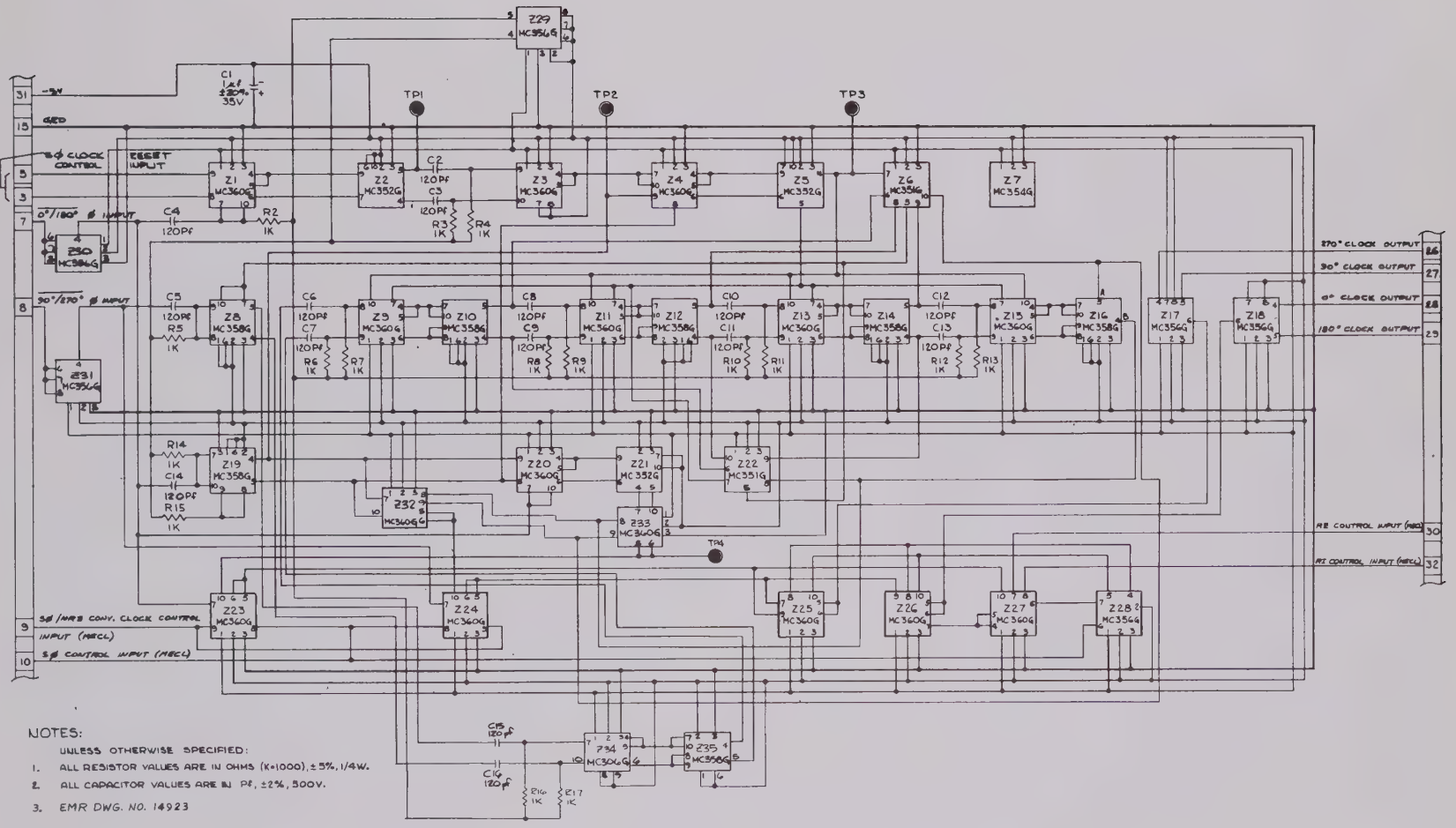


Figure 4-20 (Sheet 1 of 2). Split-Phase Clock Reset Card

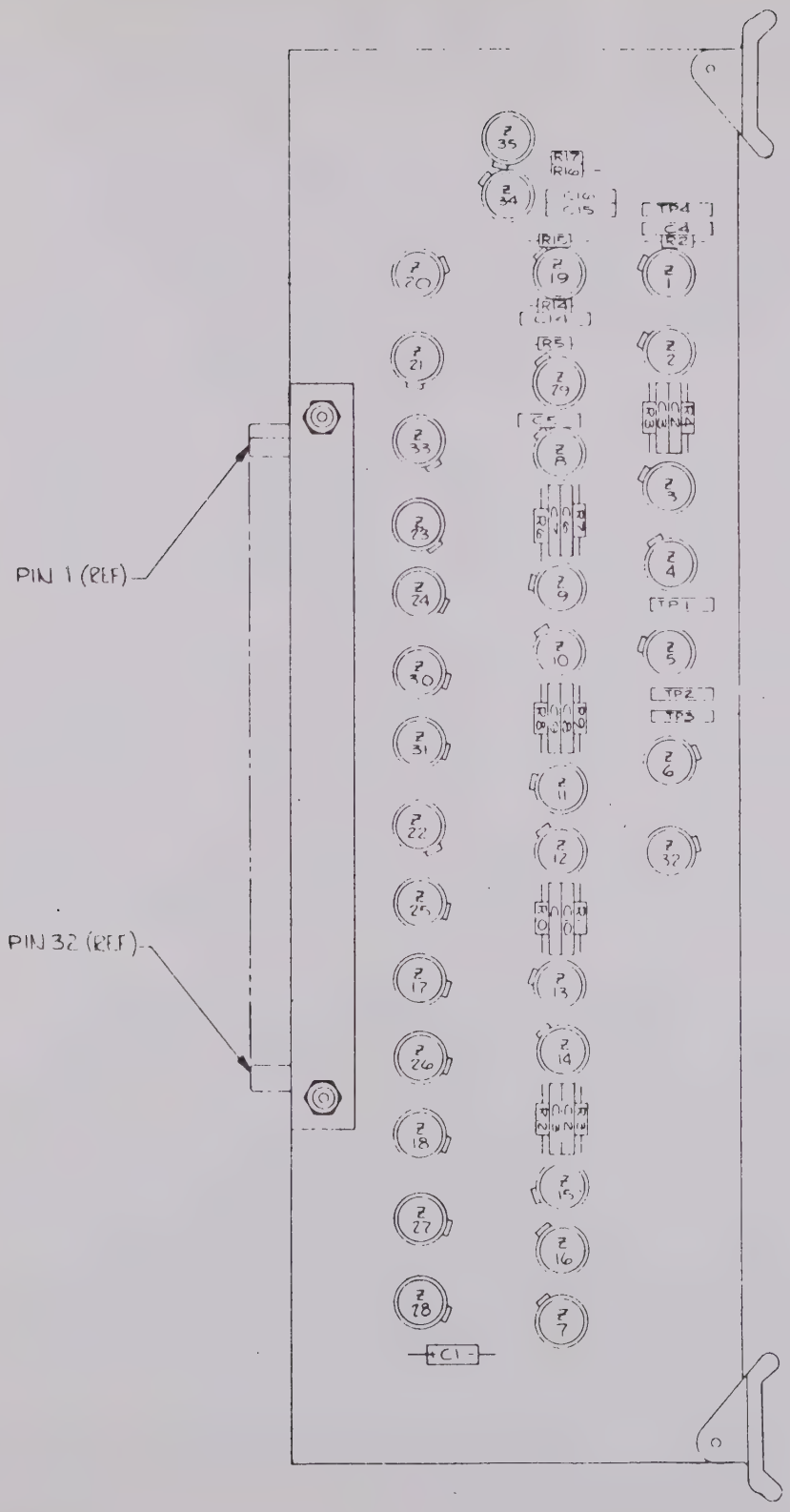


Figure 4-20. Split-Phase Clock Reset Card (Sheet 2 of 2)

pins 7 and 8 to modules Z25-Z28. Modules Z25-Z28 distributes the clock pulse inputs to modules Z17 and Z18 according to the mode of operation.

A bias driver circuit (Z7) provides the −1.15V DC bias for all split-phase clock reset circuits. A voltage filter (C1) is provided for the −5V DC.

4.3.11 Loss Lock and Counter (Ref. Figure 4-21)

The loss-lock and counter printed-wiring board (assembly no. 6511) is located in the card-file subassembly (A2) card slot 15 (J15). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The loss lock and counter circuits provide a visual display of the Model 2721 synchronization status(SYNC light located on the front panel) and provide the bit-decision circuitry with a zero-signal indication.

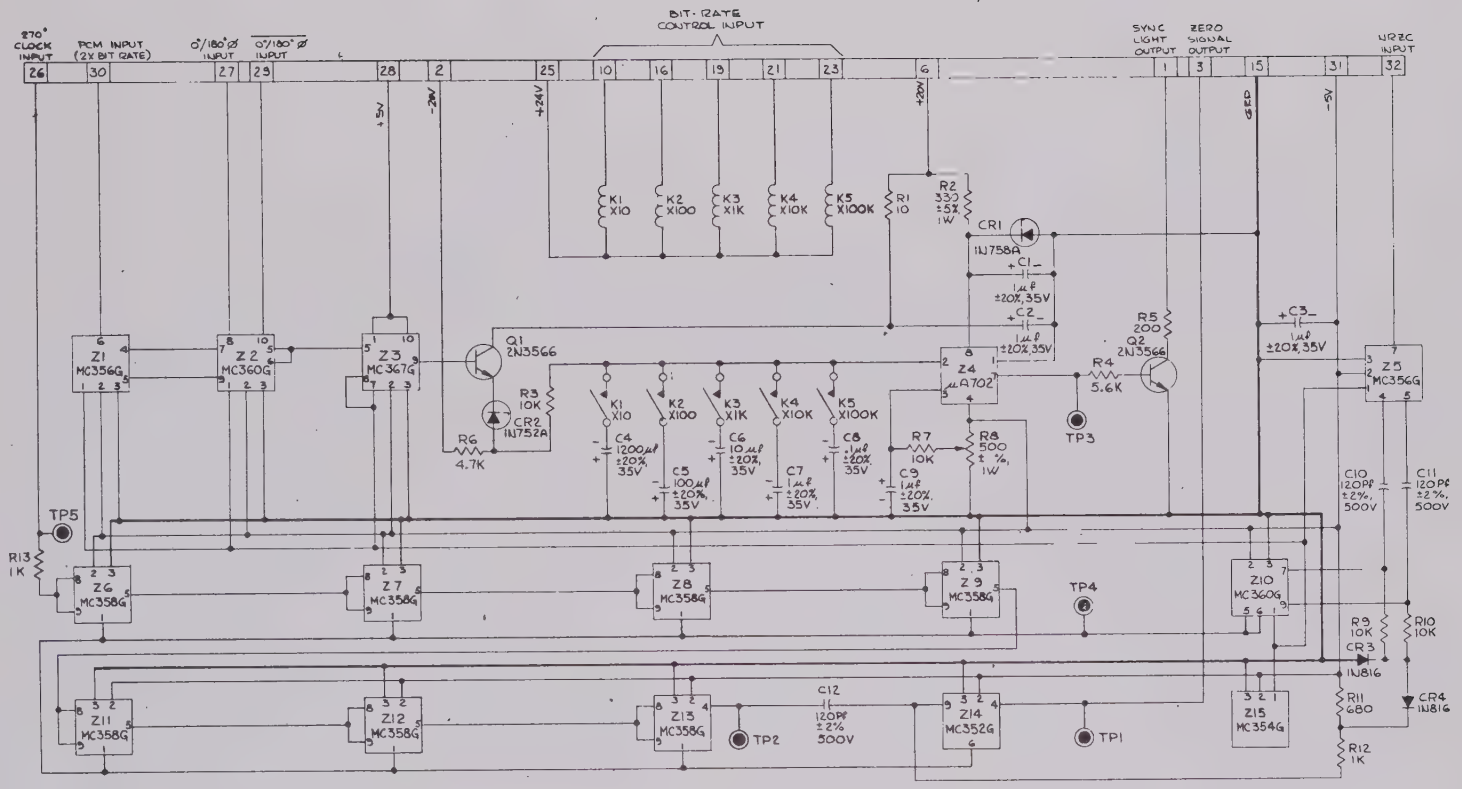
A serial PCM data signal from the phase-shifter circuits is applied to pin 30 of the loss lock and counter printed-wiring board. The serial PCM input from the phase-shifter occurs at twice the bit-rate frequency. Module Z1 provides both polarities of the serial PCM data signal applied to pin 30. The output of gate Z1 is "ORed" in module Z2 with clock pulses from pins 27 and 29.

The clock-pulse inputs applied to pins 27 and 29 of the loss lock and counter printed-wiring board are obtained from the divider circuitry. The twice-bit rate PCM output of gate Z2 is level shifted by Z3 and applied to emitter-follower Q1. An RC filter network integrates the output of emitter-follower Q1 to a DC level. The DC level is applied as one input to amplifier Z4.

The RC filter network has a fixed resistance and variable capacitance. Choice of capacitors for the filter is made by relay contact closures. The relays are controlled by the multiplier section of the bit-rate programming.

The second input to amplifier Z4 is a manually adjustable (R8) DC reference level. Amplifier Z4 compares the manually adjustable DC level with the integrated twice-bit rate PCM output and provides a control voltage for the SYNC light driver (Q2). The SYNC light driver output is applied to pin 1 of the loss lock and counter printed-wiring board. For a synchronized condition, the input on pin 2 of amplifier Z4 exceeds the DC level of the manually adjustable input on pin 3 of amplifier Z4. The Z4 output maintain SYNC light driver Q2 cut off and the front-panel SYNC light remains extinguished. An "out-of-synchronization" condition produces a DC voltage output from the integrator network which does not exceed the manually adjustable input on pin 3 of amplifier Z4. The Z4 output turns on SYNC light driver Q2 and lights the front-panel SYNC light to indicate a "loss-of-lock" condition.

The loss lock and counter printed-wiring board also contains a counter which provides the bit-decision circuitry with a loss-of-lock signal. Clock pulses from the split-phase clock reset circuitry are applied to the counter (Z6-Z9



NOTE

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4 W.

Figure 4-21. Loss-of-Lock Card (Sheet 1 of 2)

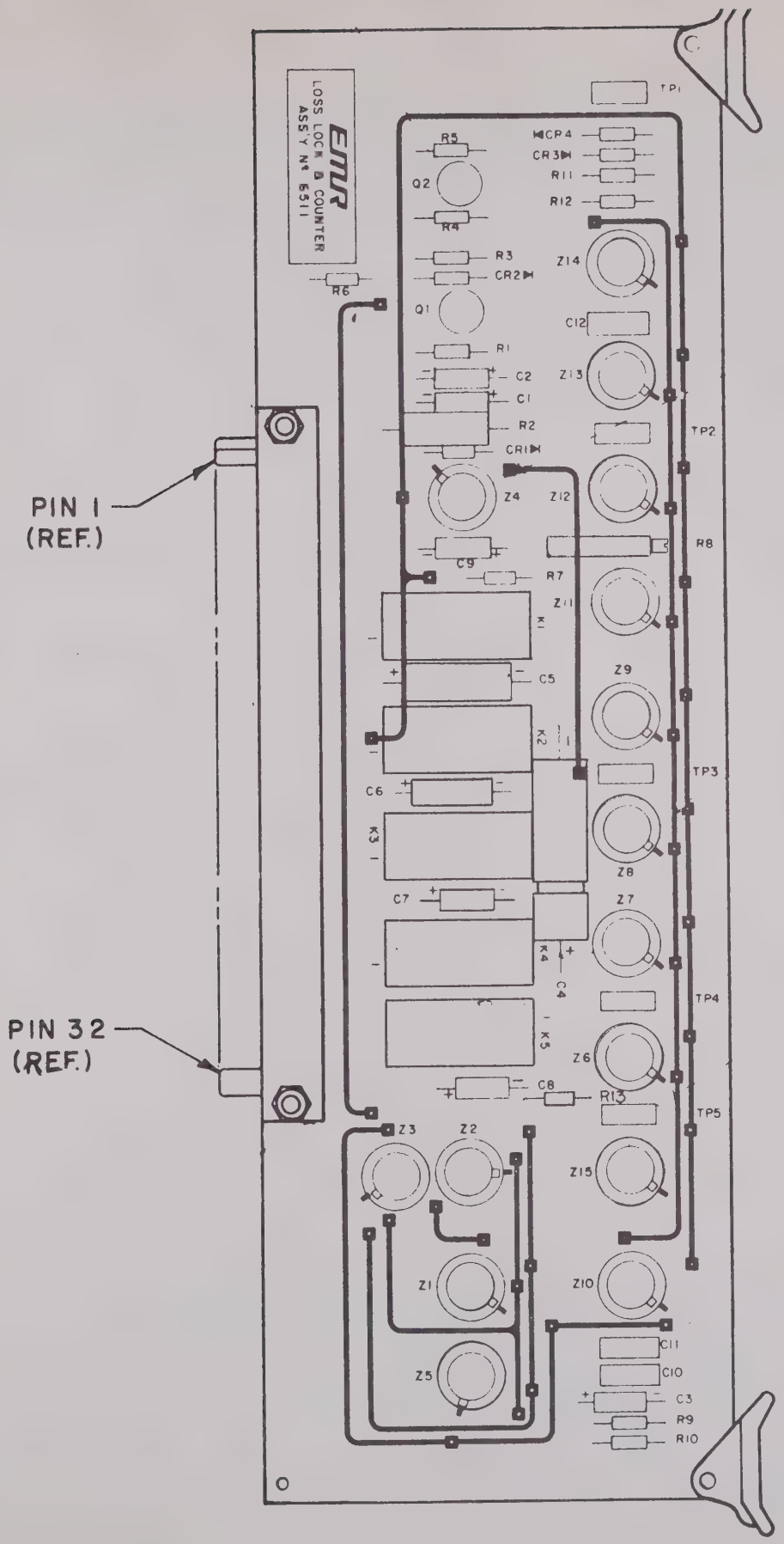


Figure 4-21. Loss-of-Lock Card (Sheet 2 of 2)

and Z11-Z13) at card input pin 26. The clock pulses (pin 26) are counted by a seven-stage binary counter (Z6-Z9 and Z11-Z13). Sixty-four consecutive clock pulses are required to trigger zero-signal reset flip-flop Z14. The output of zero signal reset flip-flop Z14 is applied to pin 3 of the loss-lock and counter printed-wiring board.

A counter reset circuit (Z5 and Z10) detects bit transitions of the bit-decision circuitry output applied to pin 32 of the loss-lock and counter printed-wiring board. A bit transition of either polarity on pin 32 will cause the counter (Z6-Z9 and Z11-Z13) to be reset. Therefore, 64 consecutive clock pulses (pin 26) must be counted without a single bit transition (pin 32 to activate zero-signal reset flip-flop Z14).

A bias driver (Z15) provides the -1.15V DC bias for the loss-lock and counter circuitry. Voltage filters are provided for the +20V DC (R1, C2) and -5V DC (C3). Zener diode CR1, capacitor C1, and resistor R2 provide the +10V DC required for the operation of Z4.

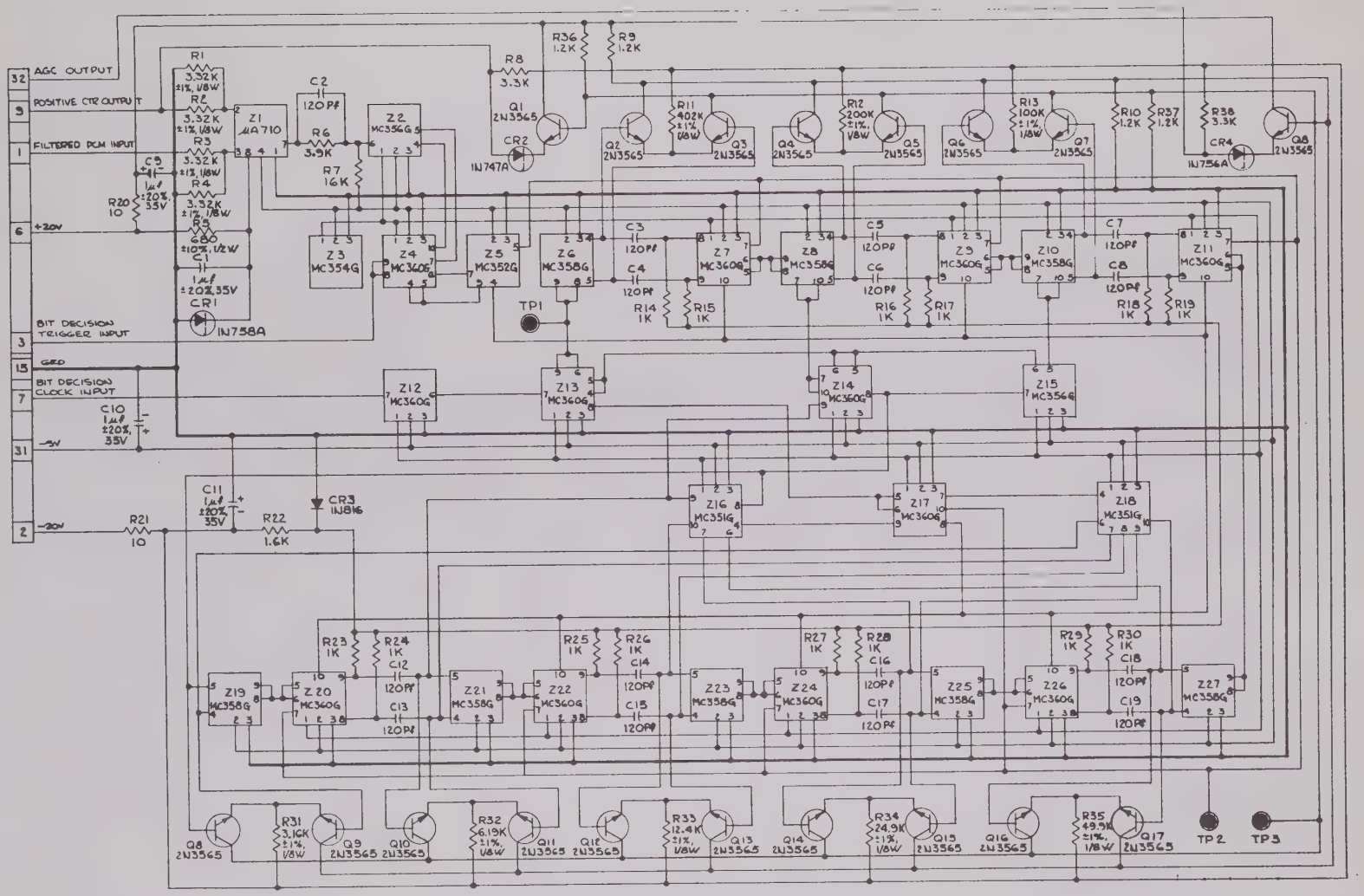
4.3.12 Positive Counter (Ref. Figure 4-22)

The positive counter printed-wiring board (assembly no. 6499) is located in the card-file subassembly (A2) card slot 9 (J9). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The positive-counter circuitry is a digital-to-analog converter (DAC) which senses the positive peak excursions of filtered serial PCM data.

Filtered serial PCM data is applied to pin 1 of the positive-counter printed-wiring-board. The filtered serial PCM data, applied to pin 1, is compared with the digital-to-analog converter (DAC) circuit output on the card.

The DAC circuit, contained on the positive-counter printed-wiring board, is composed on a bidirectional eight-bit binary counter and a resistance ladder network. The binary counter (Z6-Z11, and Z19-Z27) controls emitter-followers Q2-Q17. The resistance ladder is controlled by the emitter-followers. The resistance-ladder output is an analog voltage equivalent to the decimal value of the binary counter output. For purposes of this discussion, the eight-bit binary counter, emitter followers, and resistance ladder network will be referred to as the DAC circuit.

Comparator Z1 compares filtered serial PCM data applied to pin 1 of the positive counter printed-wiring board with the DAC circuit output. The output of comparator Z1 is applied through a level-shifter network to Z2 which applies both polarities of comparator Z1 output to gate Z4. Clock pulses (pin 3 of the positive-counter printed-wiring board) are used to gate the signal output of module Z2 in gating circuit Z4. Both polarities of gate Z4 are applied to up-down control circuit Z5. Up-down control circuit Z5 programs the binary counter in the DAC circuit to count up or to count down. However, the actual binary count in the DAC circuit is not changed until a pulse is received from the count increment circuit (Z12-Z18).



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN PF, ±2%, 500V.

Figure 4-22. Positive Counter Card (Sheet 1 of 2)

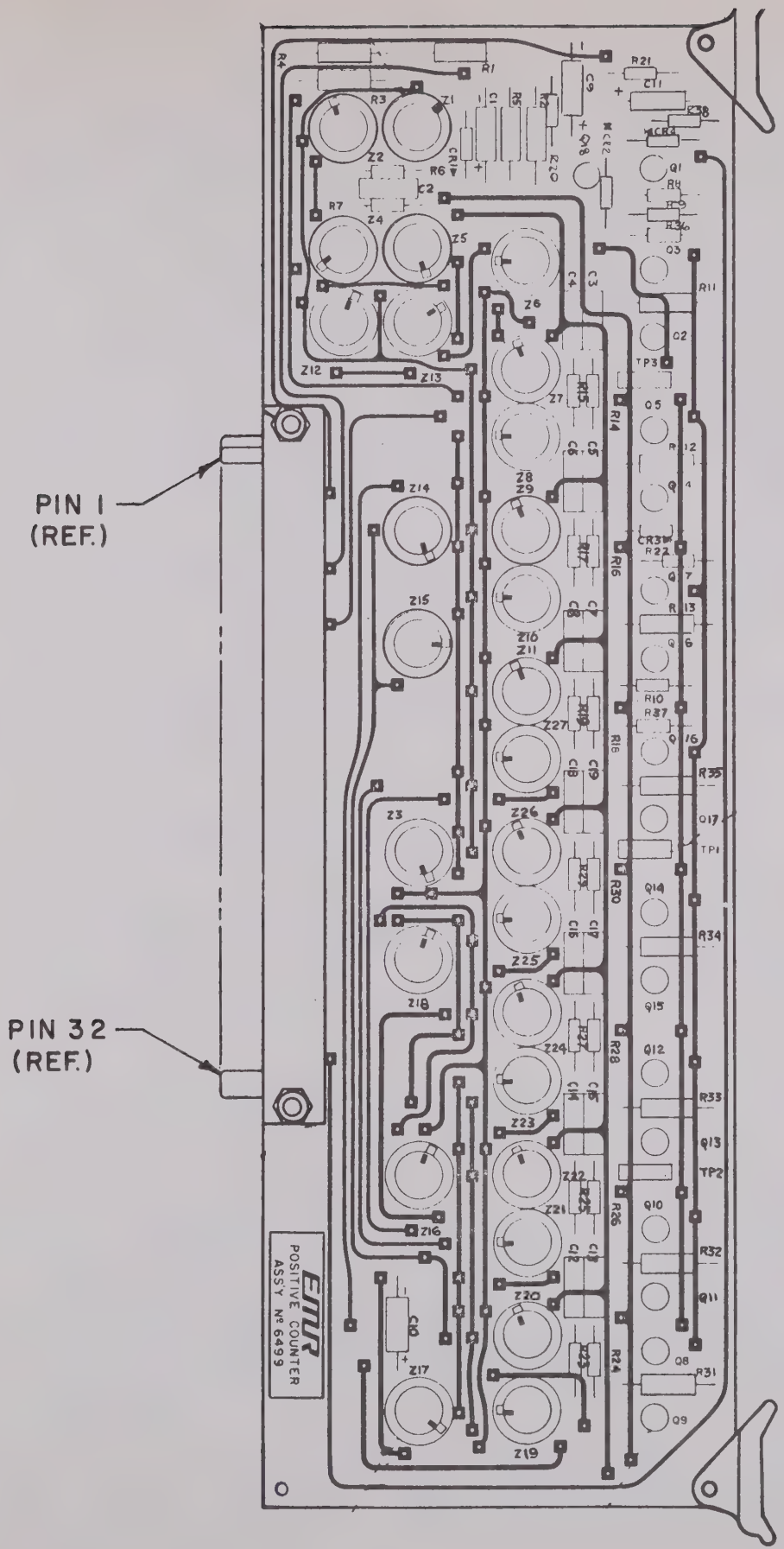


Figure 4-22. Positive Counter Card (Sheet 2 of 2)

The bit-decision clock pulse input at card pin 7 is applied to count-increment circuit Z12-Z18. The bit-decision clock pulses at pin 7 are squared, buffered, and inverted by Z12 and applied to Z13. Modules Z13-Z18 are a series of gates which sense the states of the binary counter in the DAC circuit and prevent an overflow of the binary counter. Step-voltage determinations are also made by count increment circuit Z12-Z18. Since the bit decision clock pulses at pin 7 are derived from the operating bit-rate frequency, the maximum rate of change of the DAC circuit is one step per bit. The magnitude of the steps is determined by count increment circuits Z12-Z18.

The DAC circuit output is applied to two emitter-followers (Q1 and Q8). The output of emitter-follower Q1 is applied as one input to comparator circuit Z1 and to pin 9 of the positive-counter printed-wiring board. The output of emitter-follower Q8 is applied to pin 32 of the positive-counter printed-wiring board and is used by the meter drive circuit on the input amplifier printed-wiring board to drive the RANGE lights on the Model 2721 front panel. Both outputs are analog voltages related to the most positive peak excursions of incoming filtered serial PCM data.

Bias driver Z3 provides the −1.15V bias required by the positive-counter circuitry. Voltage filters are provided for the +20V DC (R10, C9 and R5, C1), −20V DC (R21, C11), and −5V DC (C10).

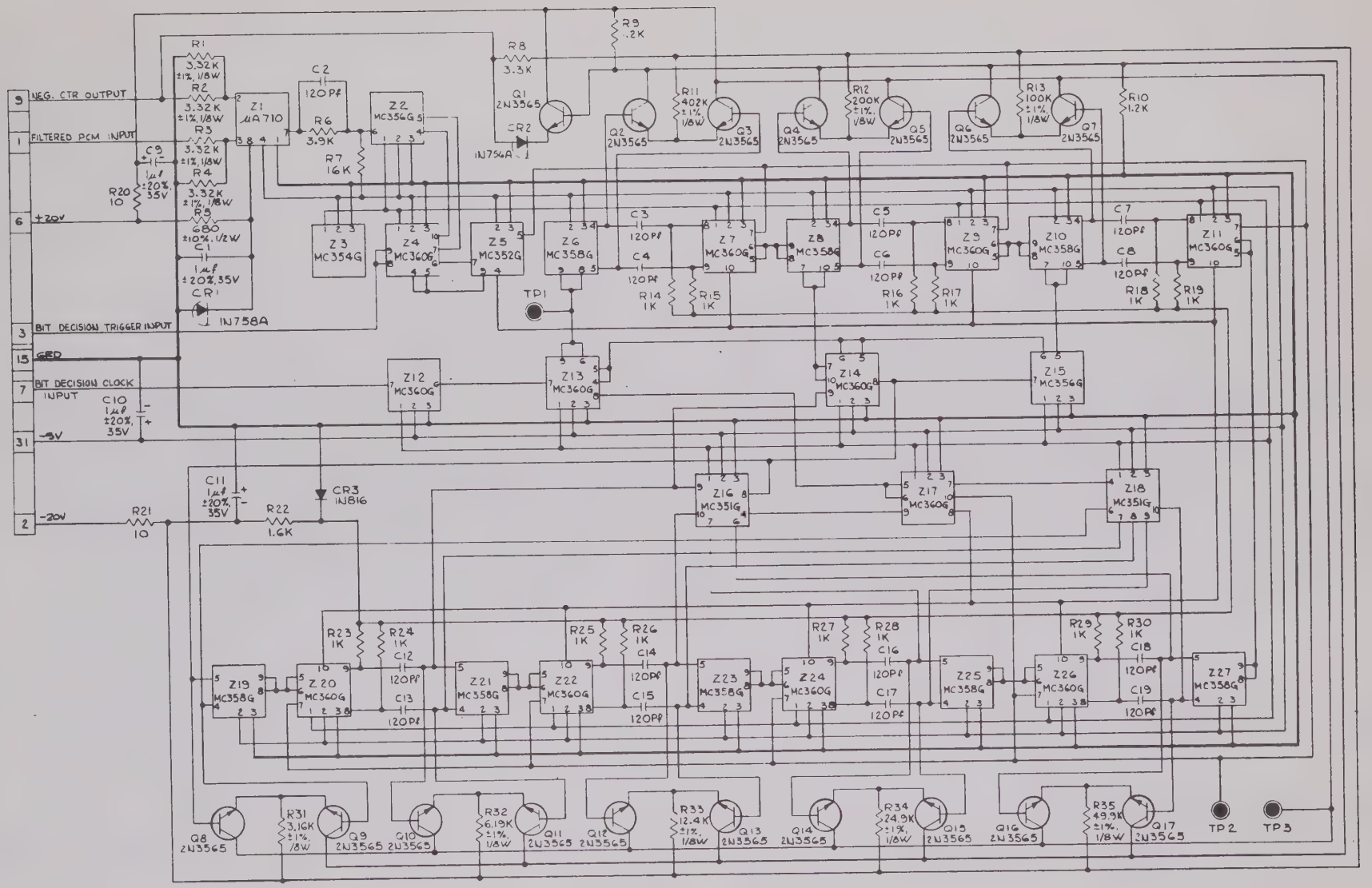
4.3.13 Negative Counter (Ref. Figure 4-23)

The negative-counter printed-wiring board (assembly no. 6497) is located in the card-file subassembly (A2) card slot 8 (J8). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The negative-counter circuitry is a digital-to-analog converter (DAC) which senses the negative peak excursions of filtered serial PCM data.

Filtered serial PCM data is applied to pin 1 of the negative-counter printed-wiring board. The filtered serial PCM data applied to pin 1 is compared with the digital-to-analog converter (DAC) circuit output on the card.

The DAC circuit, contained on the negative counter printed-wiring board, is composed of a bidirectional eight-bit binary counter and a resistance ladder network. The eight-bit binary counter (Z6-Z11 and Z19-Z27) controls emitter-followers Q2-Q17. The resistance ladder is controlled by the emitter-followers. The resistance ladder output is an analog voltage equivalent to the decimal value of the binary counter output. For purposes of this discussion, the eight-bit binary counter, emitter-followers, and resistance ladder network will be referred to as the DAC circuit.

Comparator Z1 compares filtered serial PCM data, which is applied to pin 1 of the negative counter printed-wiring board, with the DAC circuit output. The output of comparator Z1 is applied through a level shifter network to module Z2



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), ±5%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN Pf, ±2%, 500V.

Figure 4-23. Negative Counter Card (Sheet 1 of 2)

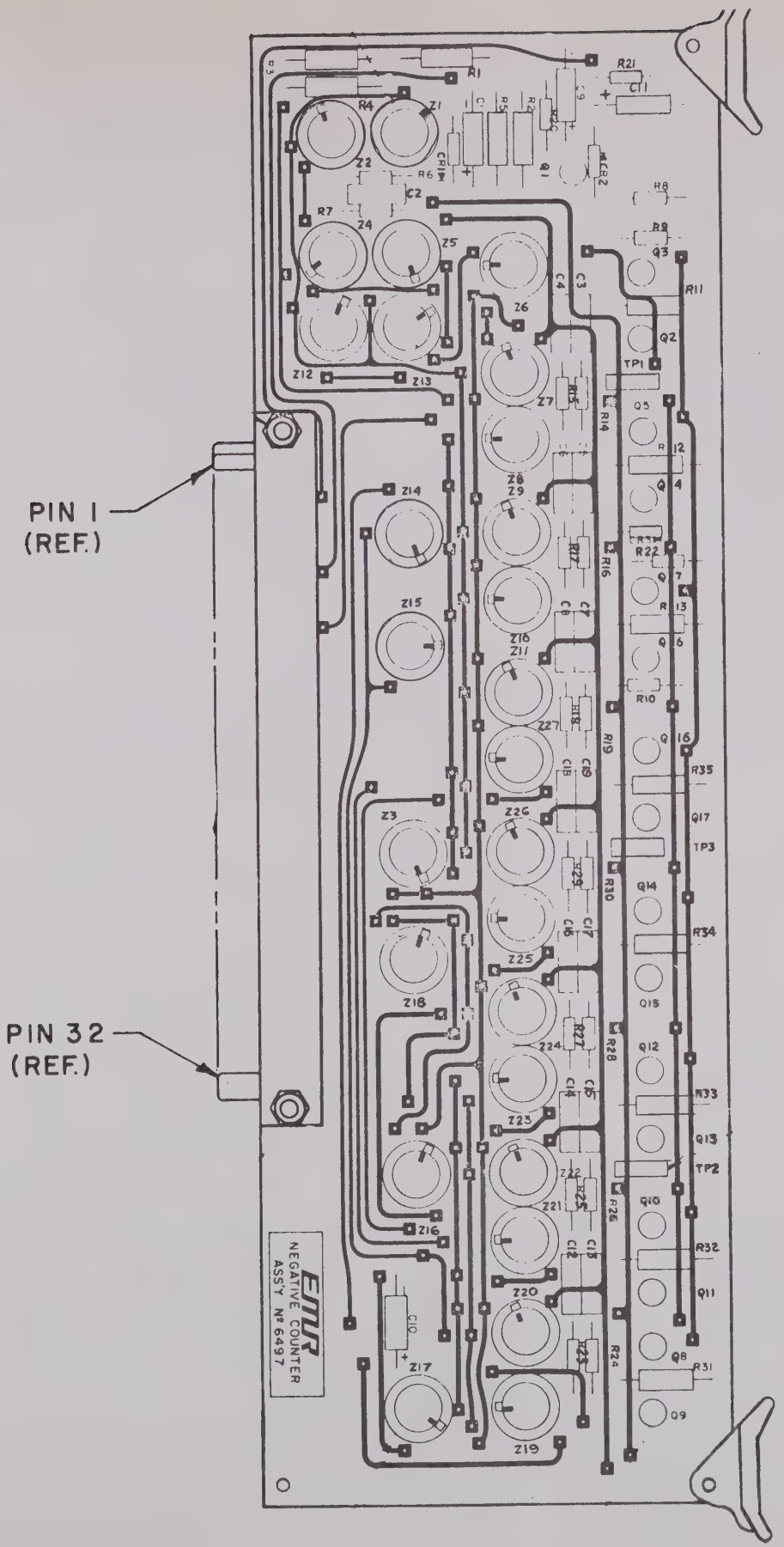


Figure 4-23. Negative Counter Card (Sheet 2 of 2)

which applies both polarities of comparator Z1 output to gate Z4. Clock pulses (pin 3 of the negative counter printed-wiring board) are used to gate the signal output of module Z2 in gating circuit Z4. Both polarities of gate Z4 are applied to up-down control circuit Z5. Up-down control circuit Z5 programs the binary counter in the DAC circuit to count up or to count down. However, the actual binary count in the DAC circuit is not changed until a pulse is received from count increment circuit Z12-Z18.

The bit-decision clock pulse input at card pin 7 is applied to count-increment circuit Z12-Z18. The bit-decision clock pulses at pin 7 are squared, buffered, and inverted by Z12 and applied to Z13. Modules Z13-Z18 are a series of gates which sense the state of the binary counter in the DAC circuit and prevent an overflow of the binary counter. Step-voltage determinations are also made by count increment circuit Z12-Z18. Since the bit-decision clock pulses at pin 7 are derived from the operating bit-rate frequency, the maximum rate of change of the DAC circuit is one step per bit. The magnitude of the steps is determined by count increment circuits Z12-Z18.

The DAC circuit output is applied to emitter-follower Q1. The output of emitter-follower Q1 is applied as one input to comparator circuit Z1 and to pin 9 of the negative counter printed-wiring board. The output of the negative counter printed-wiring board is an analog voltage equivalent to the most negative peak excursions of the incoming filtered serial PCM data.

Bias driver Z3 provides the −1.15V bias required by the negative-counter circuitry. Voltage filters are provided for the +20V DC (R20, C9), −20V DC (R21, C11), and −5V DC (C10).

4.3.14 Bit Decision and Code Converter (Ref. Figure 4-24)

The bit-decision and code-converter printed-wiring board (assembly no. 6495) is located in the card-file subassembly (A2) card slot 7 (J7). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The bit-decision and code-converter circuitry converts the filtered serial PCM data to predetermined coded PCM data outputs.

The positive- and negative-counter circuitry outputs are applied to pins 1 and 3, respectively, of the bit-decision and code-converter printed-wiring board. A summing circuit (Z3 and Z4) sums the pins 1 and 3 input voltages and provides a DC level output which is the mid-point or average of the two voltages. The average voltage output of the summing circuit is used by comparator Z5 as a reference voltage for zero crossings. Filtered serial PCM data (pin 8 of the bit-decision and code-converter printed-wiring board) is also applied to comparator Z5. By comparing the filtered serial PCM data (pin 8) with the average voltage (summing circuit output), comparator circuit Z5 provides a signal output which is directly related to positive or negative zero crossings of the filtered serial PCM data. The DC restored output of comparator circuit Z5 is applied to gate Z26.

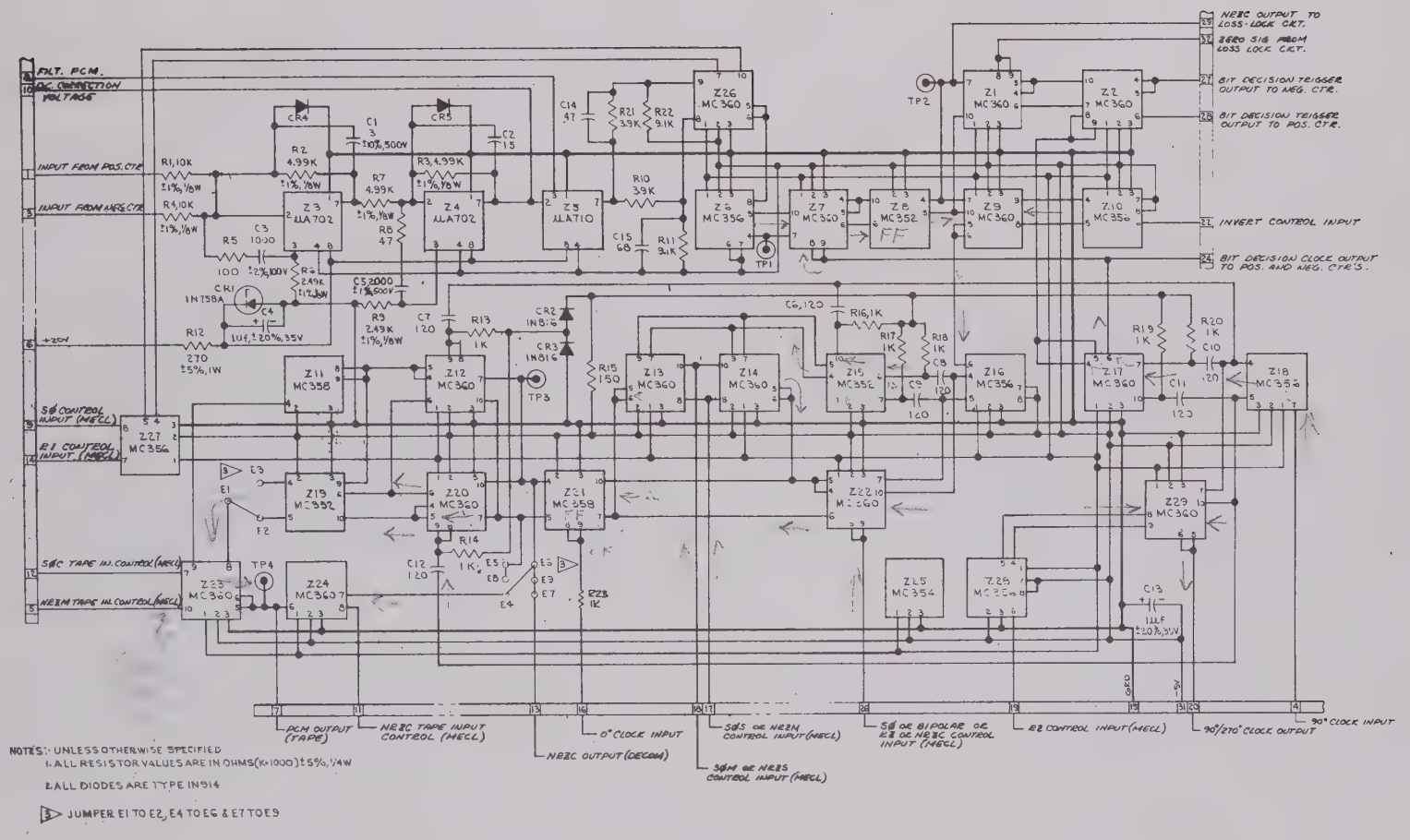


Figure 4-24. Bit Decision and Code Converter (Sheet 1 of 2)

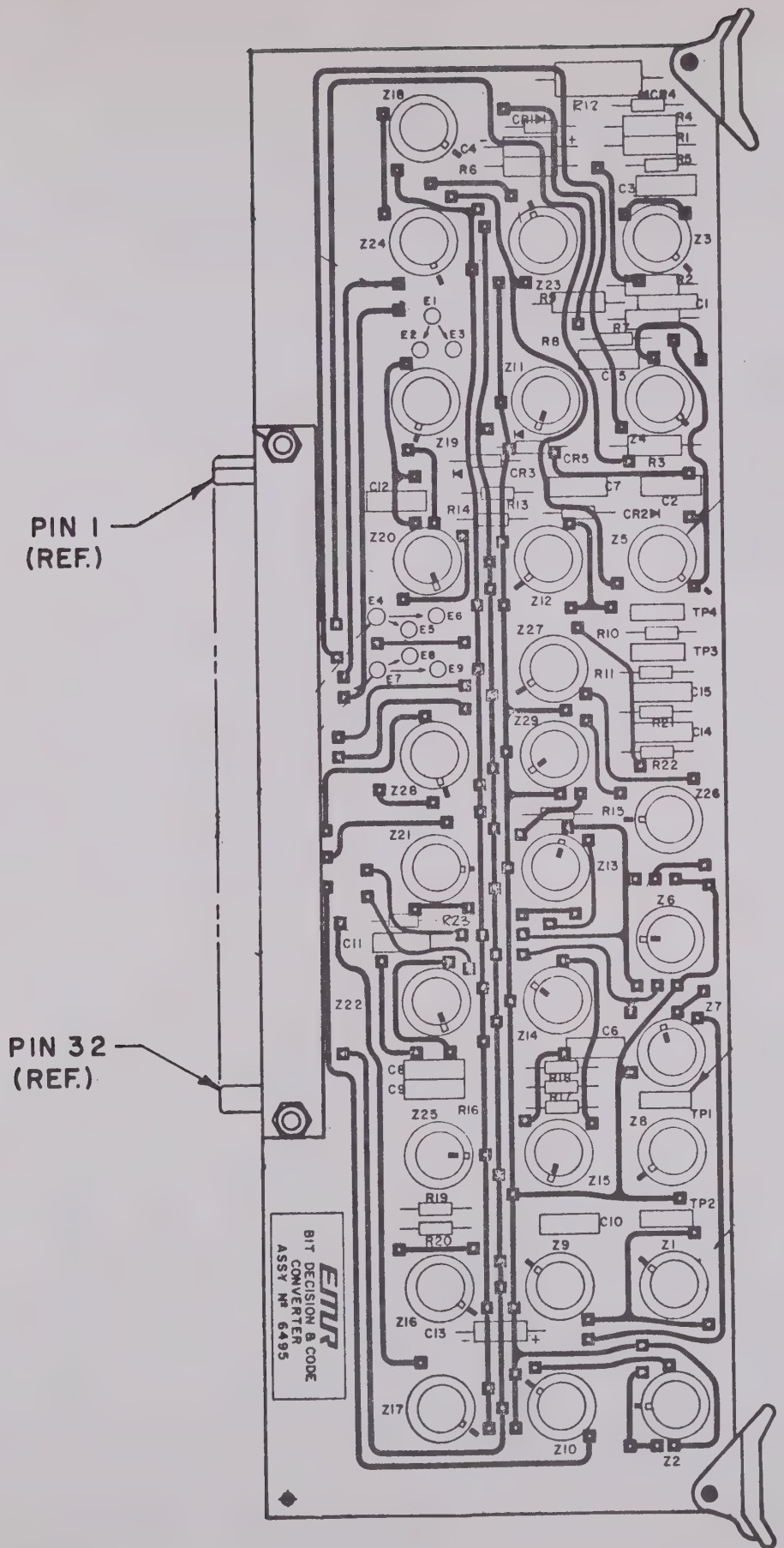


Figure 4-24. Bit Decision and Code Converter (Sheet 2 of 2)

Gate Z26 has two DC coupled PCM inputs. Both PCM inputs are derived from the comparator circuit Z5 output. A speed-up capacitor (C14) is used in one input while the other input uses a capacitor (C15) to delay the signal. Module Z26 gates either the delayed or normal signal depending on the Model 2721 operating mode. Gate Z27 controls the gating function of gate Z26. The serial PCM data output of gate Z26 is applied to bit-decision circuit Z6-Z8.

Timing for bit-decision circuit Z6-Z8 is provided by clock-pulse differentiator circuit Z17, Z18. Clock pulses from the split-phase clock-reset circuit are applied to pin 4 of the bit-decision and code-converter printed-wiring board. Both polarities of the clock pulses (pin 4) are differentiated and used for timing the bit-decision and code-converter circuitry.

Bit-decision circuit Z6-Z8 provides both polarities of the gate Z26 output. Both polarities of gate Z26 are strobed by the differentiated clock pulses from the clock-pulse differentiator circuit Z17, Z18 and applied as set and reset pulses to flip-flop Z8. Timing of the bit-decision circuit is shown in Figure 4-25.

The output of the bit-decision circuit is applied to clock-pulse inhibit circuit Z1, Z2. The clock pulse inhibit circuit generates the phase-delayed clock pulses used for timing in the positive and negative counter circuitry. Differentiated clock pulses from clock-pulse-differentiator circuit Z17, Z18 strobe bit-decision circuit Z6-Z8 output in clock-pulse inhibit circuit Z1, Z2. Timing and output waveforms of clock-pulse inhibit circuit Z1, Z2 are shown in Figure 4-25. As shown in Figure 4-26, clock-pulse inhibit circuit Z1, Z2 provides in-phase clock pulses at the bit-rate to both the positive and negative counters during an "out-of-synchronization" condition.

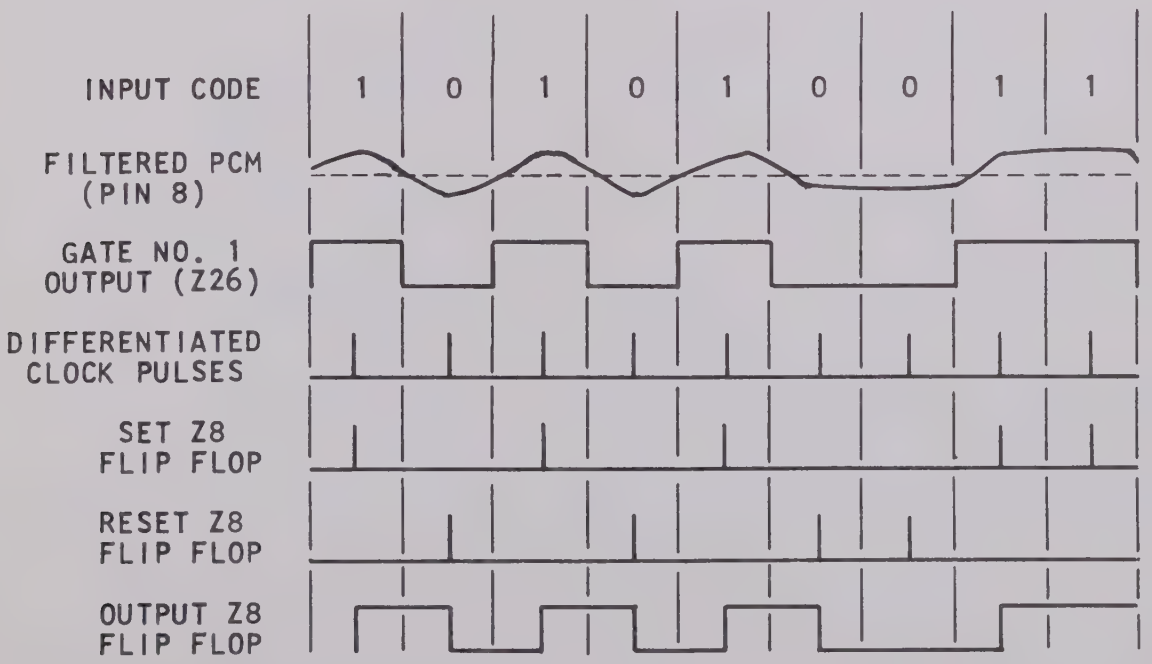


Figure 4-25. Bit-Decision Circuit Waveforms

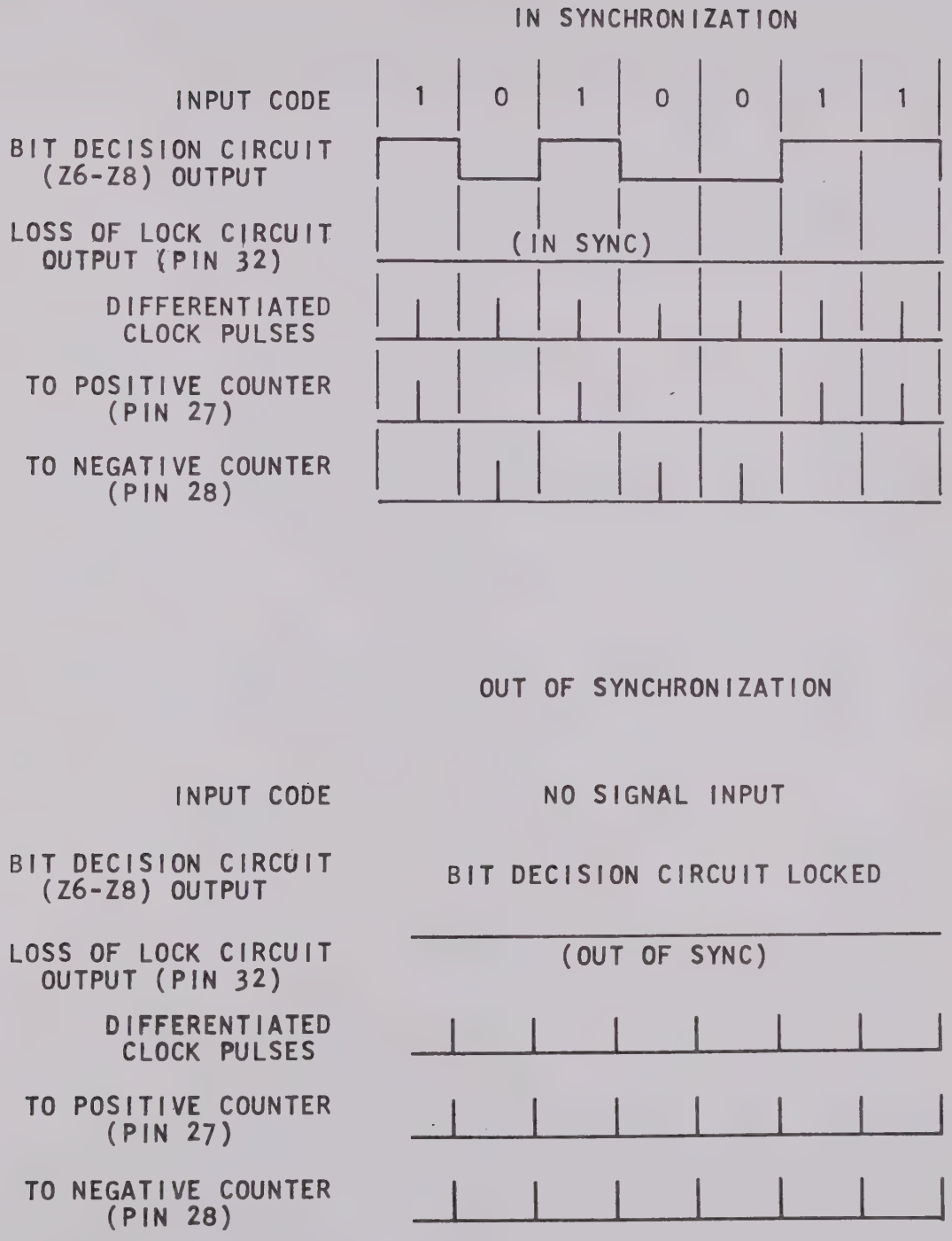


Figure 4-26. Clock Pulse Inhibit Waveforms

The remainder of the bit-decision and code-converter printed-wiring board circuitry is used for code conversion. Control of the code conversion is automatic by programming the associated control lines. The outputs of the code-conversion circuits are applied to the Model 2721 Output Amplifier.

Figure 4-27 shows the logic used to convert one of the following codes from bit-decision flip-flop 28 to NRZC: SØM, NRZS, SØS, or NRZM.

Bias driver circuit Z25 provides the -1.15V bias levels for all bit-decisions and code-converter circuitry. Zener diode CR1, resistor R12, and capacitor C4 provides +10V DC to operate modules Z3 through Z5. Capacitor C13 filters the -5V DC input.

4.3.15 Output Amplifier (Ref. Figure 4-28)

The output-amplifier printed-wiring board (assembly no. 11413) is located in the card-file subassembly (A2) card slot 16 (J16). Integrated circuits and discrete components are used for all printed-wiring-board circuitry. The output-amplifier circuitry provides level changing and drive capabilities for all signals presented as outputs of the Model 2721. In addition, the output-amplifier provides buffering to the eight instruction-line inputs to control cards 1 through 4.

Level changers Z7, Z12, Z13, and Z4 shift the voltage levels of the incoming serial data and timing signals to predetermined voltage levels required by driver circuits Z8 through Z10 and tape output amplifier Q1-Q3. Driver circuit outputs are applied to the pins of the output-amplifier printed-wiring board as follows:

a. Pin 5--90° Clock

b. Pin 8--180° Clock

c. Pin 7--270° Clock

d. Pin 11--0° Clock

e. Pin 10--NRZC (Data out)

Amplifier circuit Q1-Q3 is provided for the selected record output. Selection of the code is made in the bit-decision and code-converter circuits. The output of the bit-decision and code-converter circuits is applied to pin 4 of the output-amplifier printed-wiring board. The serial PCM data on pin 3 is level-shifted by Z7, amplified by amplifier circuit Q1-Q3, and applied to pin 1 of the output-amplifier printed-wiring board.

Bias driver circuit Z11 provides the -1.15V DC bias levels for all output amplifier circuitry.

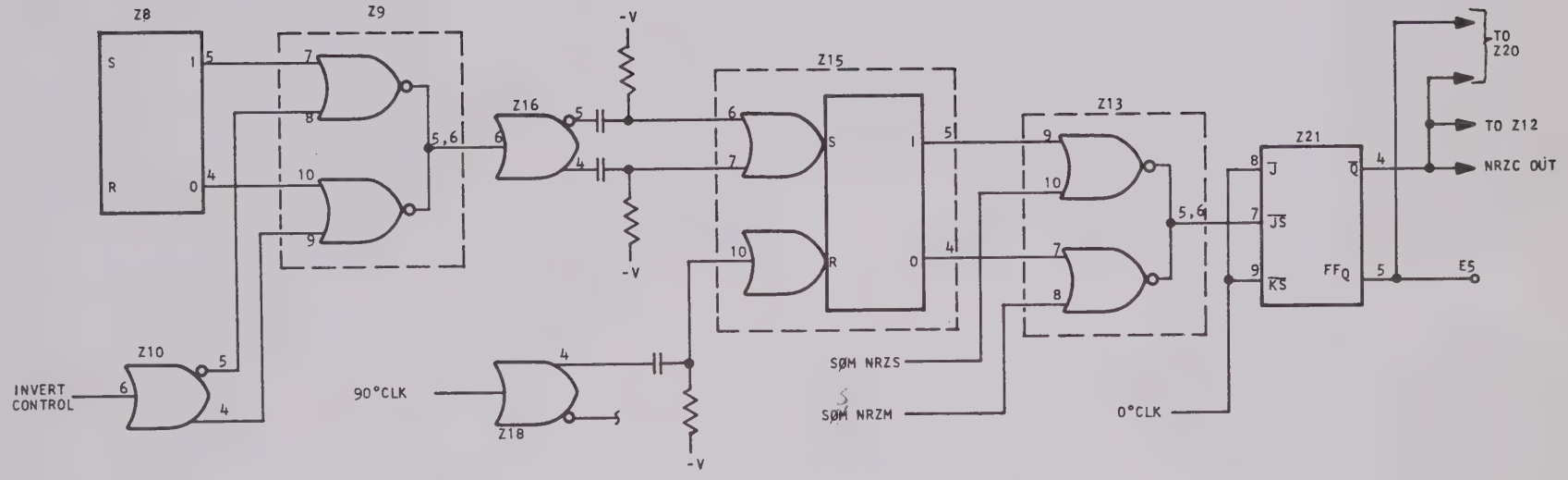
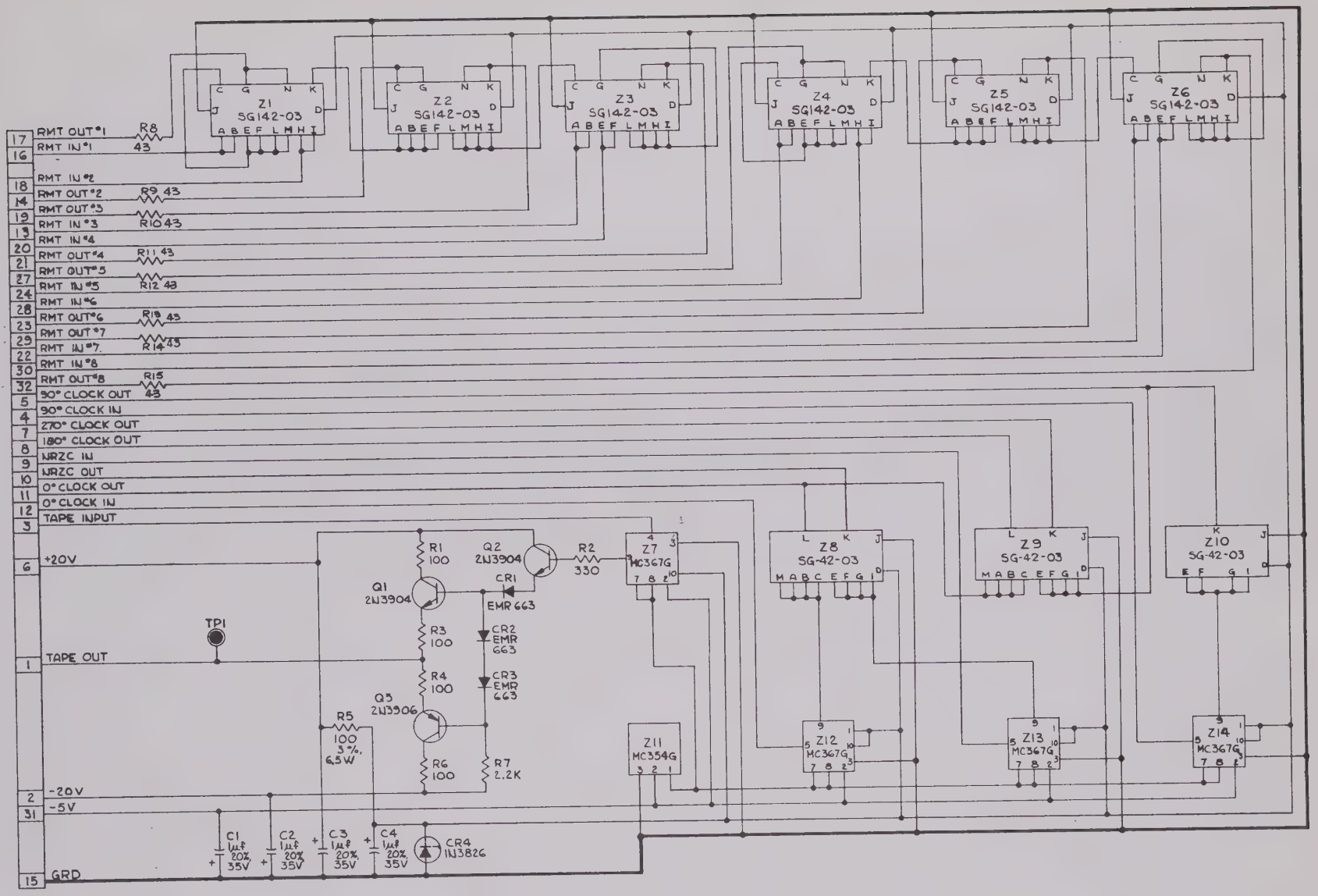


Figure 4-27. Example of Code Conversion Logic



NOTE

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4W.

Figure 4-28. Output Amplifier Card (Sheet 1 of 2)

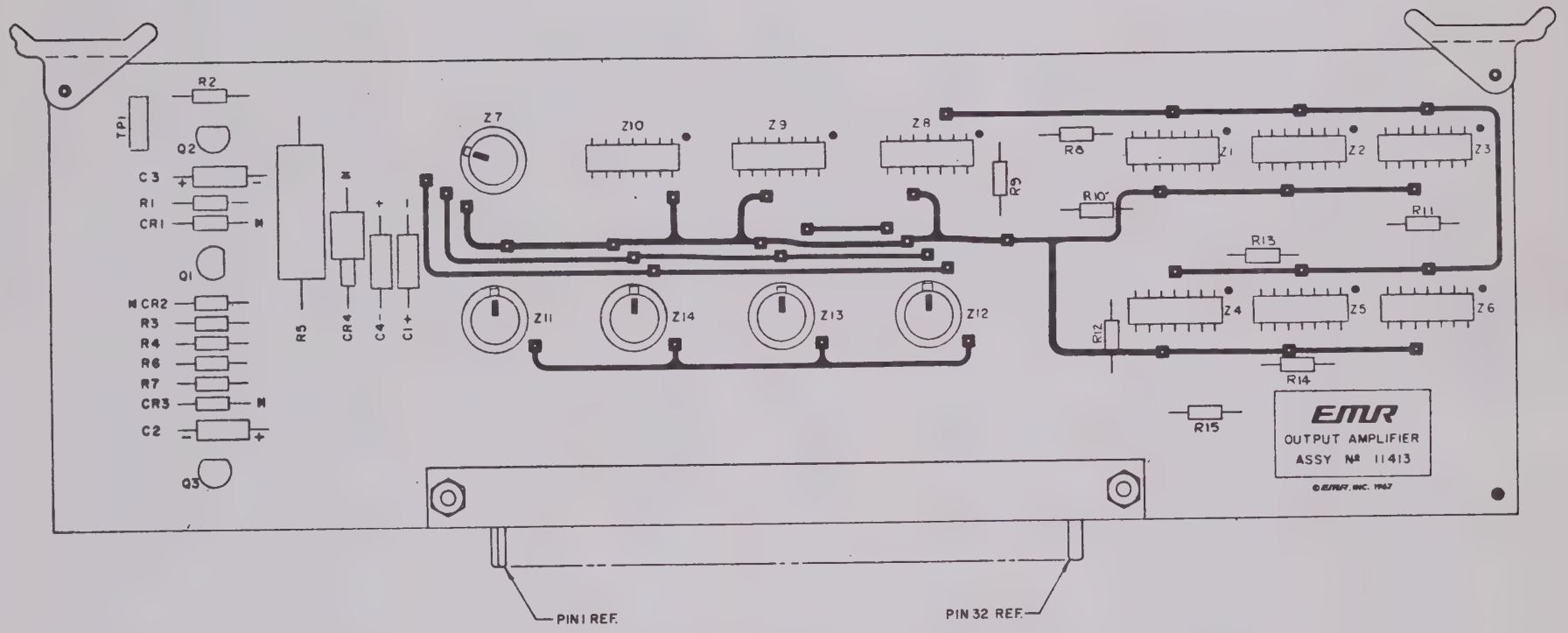


Figure 4-28. Output Amplifier Card (Sheet 2 of 2)

Voltage filters are provided for the +20V DC (C3), -20V DC (C2), and -5V DC (C1).

Zener diode CR4 provides the +5V DC level required by the output-amplifier circuits. Voltage filtering for zener diode CR4 is provided by R5 and C4.

4.3.16 Control Card No. 1 (Ref. Figures 4-29 and 4-30)

The control card no. 1 printed-wiring board (assembly no. 11384) is located in the card-file subassembly (A2) card slot 17 (J17). Integrated circuits and discrete components are used for all printed-wiring-board circuitry.

Control card no. 1 performs the following functions:

a. Decodes the four-bit module address received from an external computer I/O device.

b. Generates the input request command applied to the computer I/O device when the Model 2721 can receive remote programming instructions.

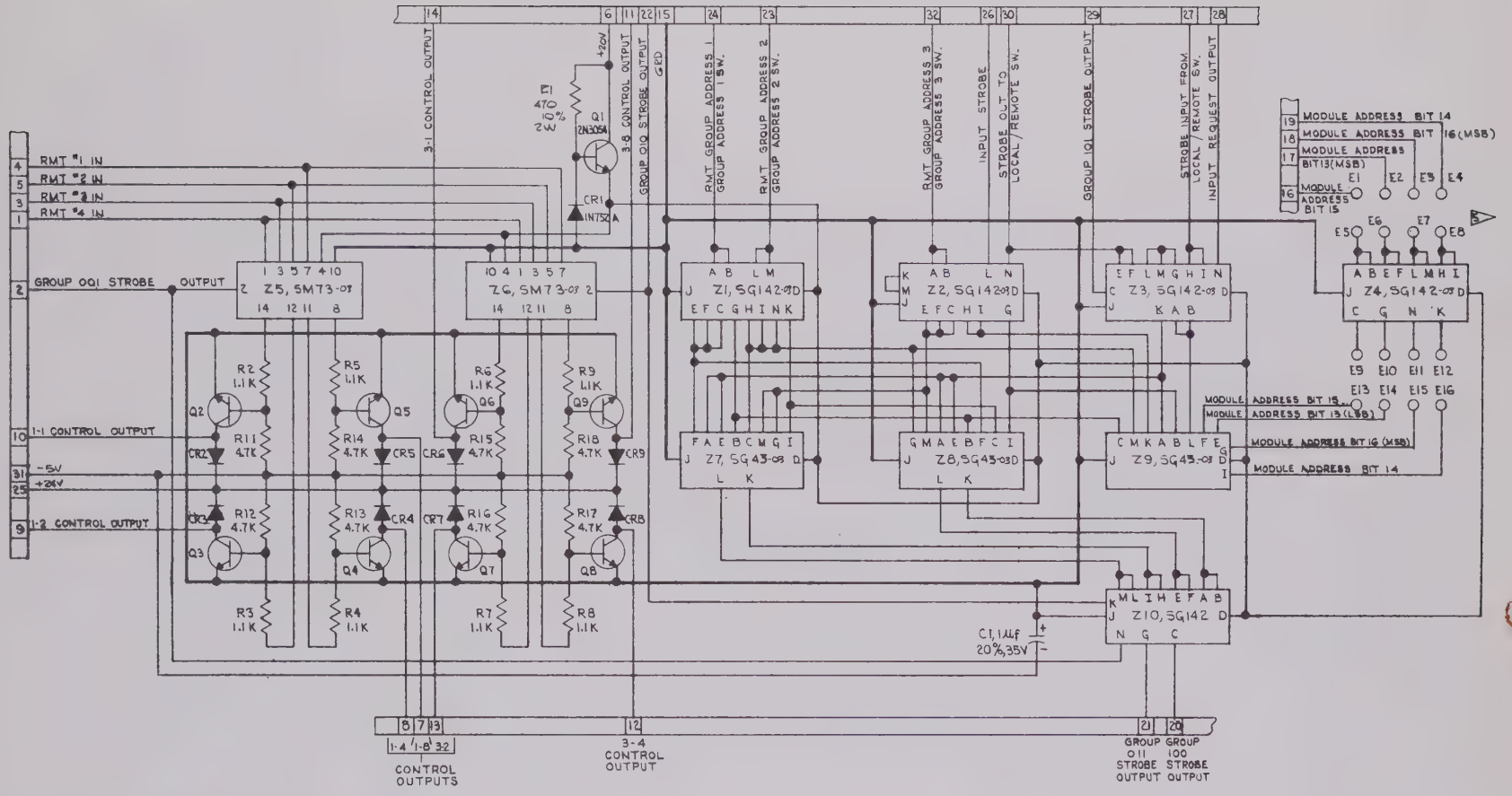
c. Receives the input strobe signal from the computer I/O device and generates the five group strobe lines used to enter local or remotely programmed instructions into the five group instruction storage registers in the Model 2721.

d. Generates the group 001 and group 010 lamp control outputs used to energize the group 001 and group 010 bit-rate selection relays and to light the associated bit-rate selection indicators on the Model 2721 front panel.

See Figure 4-30. Module address bits 13 through 16 from an external computer I/O device are applied to control card no. 1 at card pins 16 through 19. The module address to be decoded is determined by the customer. The customer selects the module address to be decoded by jumpering the appropriate E-pins on the card.

The Model 2721 accepts instructions from the external computer I/O device only when in REMOTE mode and when the correct module address is decoded.

Pins E5 through E8 represent the four inputs to inverter module Z4. When a module address bit is to be inverted, the selected bit at pins E1 through E4 is jumpered to an input to inverter module Z4 and the corresponding inverter circuit output at pins E9 through E12 is jumpered to the decoder circuit inputs at pins E13 through E16. When the module address bits do not require inversion for decoding, the module address inputs at pins E1 through E4 are jumpered directly to decoder inputs E13 through E16, bypassing inverter module Z4.



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000) 5%, 1/4W
2. ALL DIODES ARE TYPE IN914 CONTROLLED BY EMR DWG. 636.
3. ALL TRANSISTORS ARE TYPE 2N3566.
4. DIODE TYPE 1N752A CONTROLLED BY EMR DWG. 642.

5. MODULE Z4 CONTAINS FOUR INVERTER CIRCUITS. PINS E13 THROUGH E16 ARE INPUTS TO DECODER MODULE Z9.

   FOR NON-INVERTED INPUTS TO DECODER MODULE Z9, BYPASS MODULE Z4 BY JUMPERING APPROPRIATE MODULE ADDRESS INPUTS (PINS E1 THROUGH E4) TO CORRESPONDING DECODER-MODULE Z9 INPUTS (E13 THROUGH E16).

   TO INVERT INPUTS TO DECODER MODULE Z9, CONNECT APPROPRIATE MODULE ADDRESS INPUTS (PINS E1 THROUGH E4) TO CORRESPONDING INVERTER-MODULE INPUTS (E5 THROUGH E8) AND JUMPER APPROPRIATE INVERTER-MODULE OUTPUTS (PINS E9 THROUGH E12) TO CORRESPONDING DECODER-MODULE Z9 INPUTS (PINS E13 THROUGH E16).

Figure 4-29. Control Card No. 1 (Sheet 1 of 2)

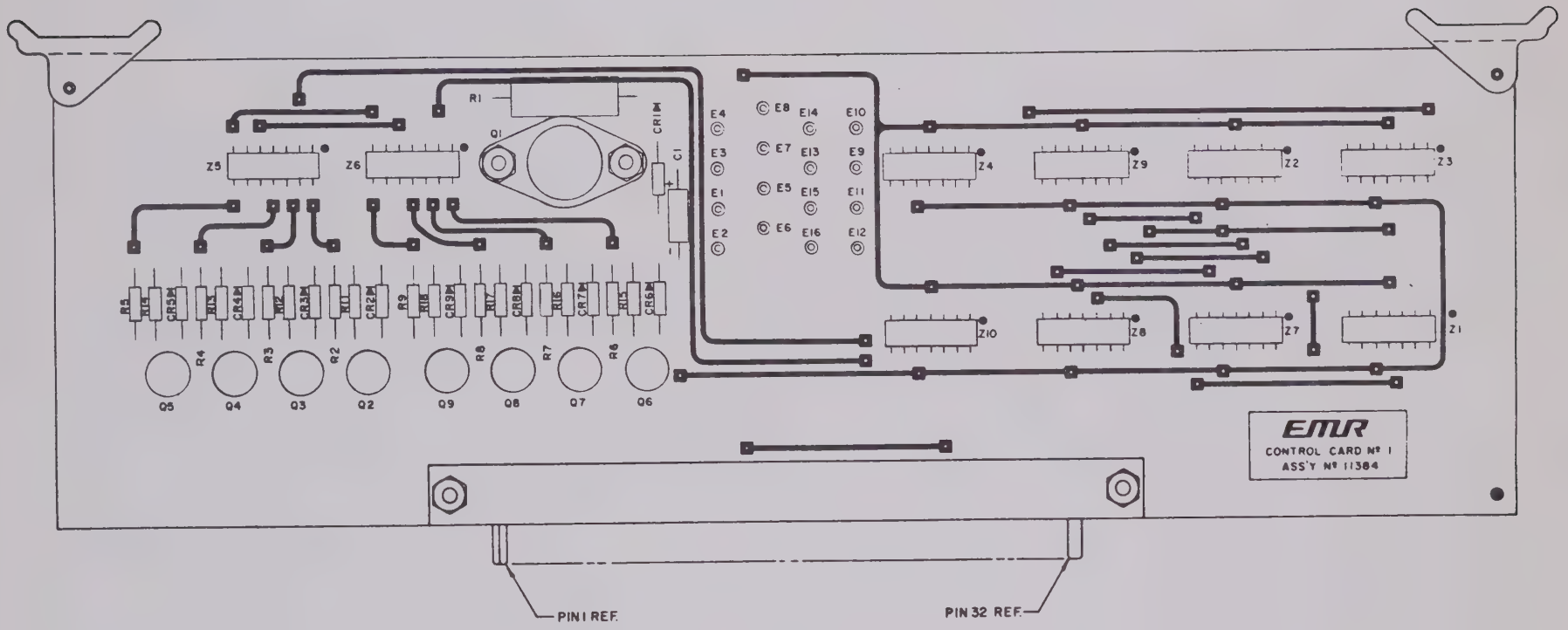


Figure 4-29. Control Card No. 1 (Sheet 2 of 2)

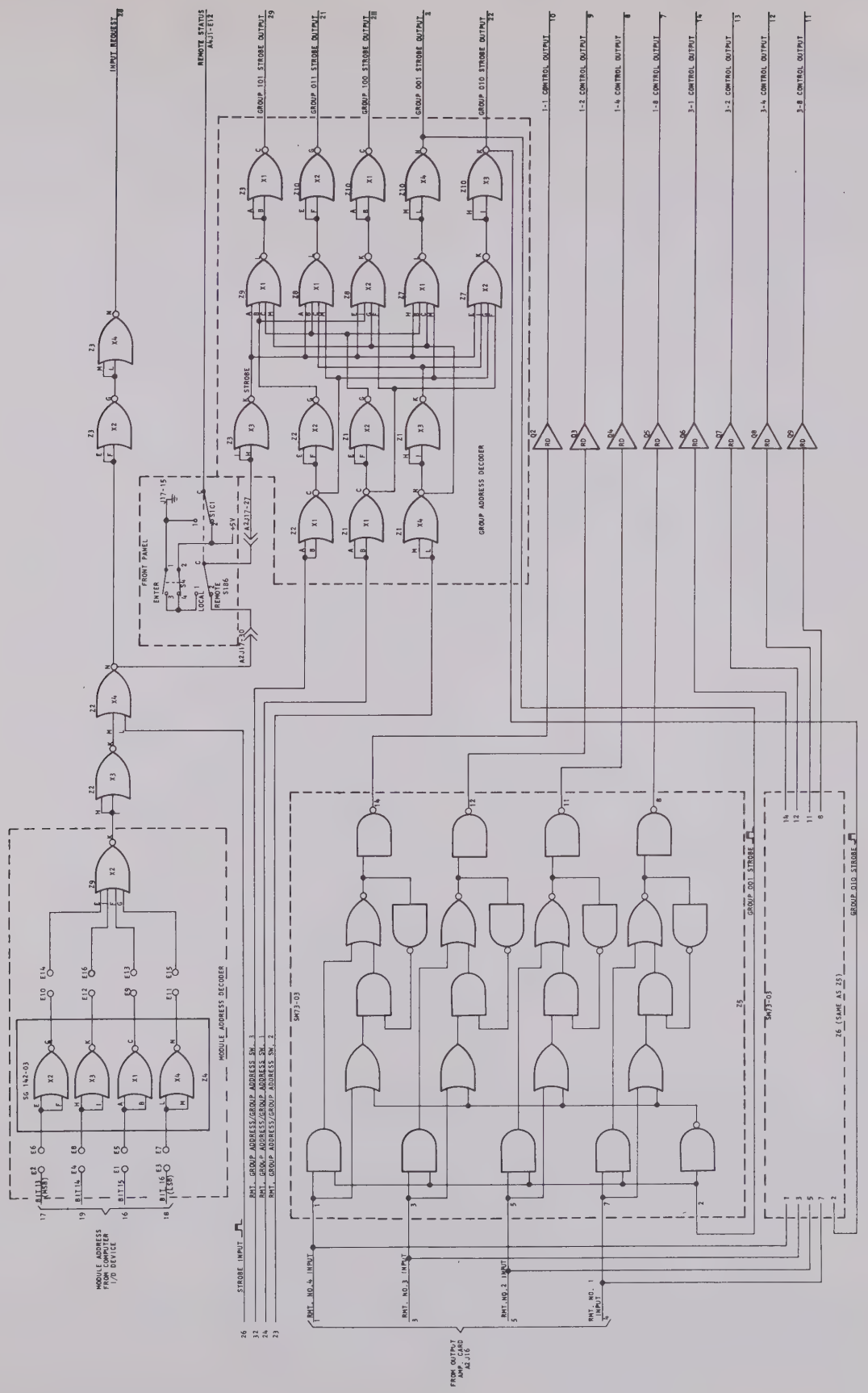


Figure 4-30. Control Card No. 1, Logic Diagram

NAND gate Z9X2 decodes the four-bit module address input from the computer I/O devices. When the correct module address is applied to the Model 2721, all inputs to NAND gate Z9X2 are at a logic ONE (+3V) level and the Z9X2 output is at a logic ZERO (0V) level. The logic ZERO output from NAND gate Z9X2 is inverted by NAND gate Z2X3 and applied as a logic ONE level to the input of NAND gate Z2X4.

The strobe input from the computer I/O device is applied through card pin 26 as the second input to NAND gate Z2X4. The positive-going strobe-pulse is gated by Z2X4 and applied as a negative-going pulse to card pin 30 and to the input to NAND gate Z3X2.

The negative-going strobe-pulse input to NAND gate Z3X2 is double inverted by NAND gate Z3X2 and Z3X4 and applied as a negative-going INPUT REQUEST output to pin 28 of the card. The INPUT REQUEST output at card pin 28 is at a logic ONE level when the Model 2721 can accept instructions from the computer I/O device. During the time when the input strobe-pulse is entering instructions into the Model 2721 storage registers, the negative-going INPUT REQUEST output at card pin 28 prevents the computer I/O device from changing the data on the instruction-line inputs to the Model 2721. At the end of the strobe-pulse, the output at card pin 28 again rises to a logic ONE level and new instructions can be applied to the Model 2721.

The negative-going strobe pulse at J17-30 is applied to S1B6-2 of the front-panel LOCAL-REMOTE switch. When the LOCAL-REMOTE switch is in the REMOTE position, the switch applies the negative-going strobe-pulse to NAND gate Z3X3 of the group address decoder. In the REMOTE position, segment S1C1 of the LOCAL-REMOTE switch applies a logic ONE level of +5V to pin E12 of output connector J1 on rear panel A4. The +5V REMOTE STATUS level at A4J1-E12 is applied to the computer I/O device to indicate that the Model 2721 is in REMOTE mode and can accept instructions when a COMPUTER REQUEST output is present. In the LOCAL position of the LOCAL-REMOTE switch, segment S1C1 applies a ground-level REMOTE STATUS output to the computer I/O device to indicate that the Model 2721 is in LOCAL mode and can not accept instructions from the computer.

As shown in Figure 4-30, the circuits comprising the group address decoder receive the negative-going strobe-pulse input from Z2X4 and the three group address lines from the front-panel GROUP ADDRESS switches or from an external computer I/O device. The group address decoder circuits generate five independent strobe outputs. The group address decoder applies a strobe-pulse output to the Model 2721 instruction storage registers selected by the GROUP ADDRESS switches or addressed by an external computer I/O device.

To obtain a particular group strobe output, all inputs to the associated four-input NAND gate in the group address decoder must be simultaneously at a logic ONE level. For example, to set up the first two most-significant digits of the bit rate, group address 001 must be selected by the front-panel GROUP ADDRESS switches or by the external computer I/O device.

The selected group address applies a logic ONE level to card pin 24 and logic ZERO levels to card pins 23 and 32. NAND gates Z1X1, Z2X1, and Z1X4 invert the applied inputs. NAND gate Z1X1 applies a logic ZERO level to NAND gates Z7X2 and Z8X2 to inhibit the group 010 and 100 strobe outputs to the associated instruction storage registers.

The logic ONE level at the output of Z2X1 is inverted to a logic ZERO level by NAND gate Z2X2 and applied as an inhibit input to NAND gates Z9X1 and Z8X2. With NAND gates Z9X1 and Z8X2 inhibited, the group 101 and group 100 strobe outputs to the associated instruction storage registers are inhibited.

The logic ONE level outputs from NAND gates Z2X1, Z1X2, and Z1X4 condition the inputs to NAND gate Z7X1. With three of the inputs to NAND gate Z7X1 at a logic ONE level, the positive-going strobe-pulse output from NAND gate Z3X3 is gated by NAND gate Z7X1, inverted by NAND gate Z10X4, and applied as a positive-going strobe-pulse output to group 001 instruction storage register module Z5 and to card pin 2. The positive-going strobe-pulse is applied to the second group 001 instruction storage register located on control card no. 2. The positive-going strobe-pulse transfers the eight-line bit-rate selection instructions into storage. The stored instructions control the selection of the first two most-significant digits of the bit rate.

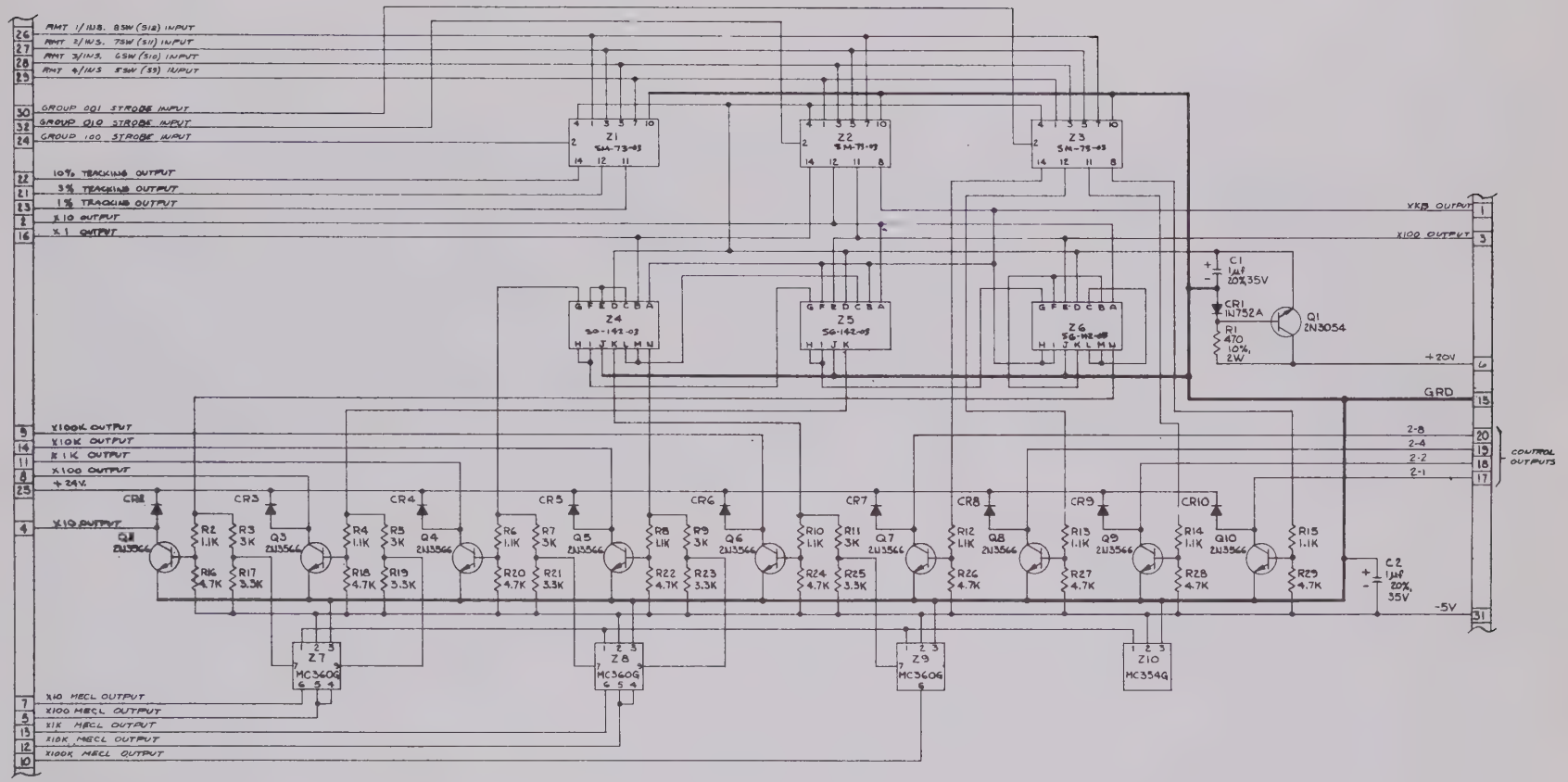
Z5 and Z6 are identical four-bit storage registers. See Z5 in Figure 4-30. Each stage of the register has a feed back ring composed of a NOR gate, NAND gate, AND gate and OR gate. When a new bit is available on one of the remote input lines, it is stored in the following manner. The group 001 strobe is inverted by a NAND gate and applied to the OR gate of all four stages to break the feed back loops. This permits the bits on the remote input lines to enter via the other input to each OR gate and remain in its respective stage when the strobe is removed.

When selected, the group 010 strobe output from NAND gate Z10X3 is applied to group 010 instruction storage register module Z6 and through card pin 22 to the second group 010 instruction storage register module located on control card no. 2. The stored group 010 instructions control the selection of the least-significant digit of the bit-rate and the bit-rate multiplier. Refer to Figure 4-1 for the distribution of the remaining group strobe outputs.

The operation of the group address decoder during LOCAL operation is the same as for REMOTE operation except the negative-going strobe input to NAND gate Z3X3 is provided by the front-panel ENTER switch. When ENTER switch S4 is depressed, a ground level from A2J17-15 is applied through S1B6 of the LOCAL-REMOTE switch and card pin 27 to NAND gate Z3X3.

4.3.17 Control Card No. 2 (Ref. Figures 4-31 and 4-32)

The control card no. 2 printed-wiring board (assembly no. 11382) is located in the card-file subassembly (A2) card slot 18 (J18). Integrated circuits and discrete components are used for all printed-wiring-board circuitry.



NOTE

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4W.
2. ALL DIODES ARE TYPE 1N914 CONTROLLED BY EMR DWG. 6436.
3. DIODE TYPE 1N752A CONTROLLED BY EMR DWG. 6421.

Figure 4-31. Control Card No. 2 (Sheet 1 of 2)

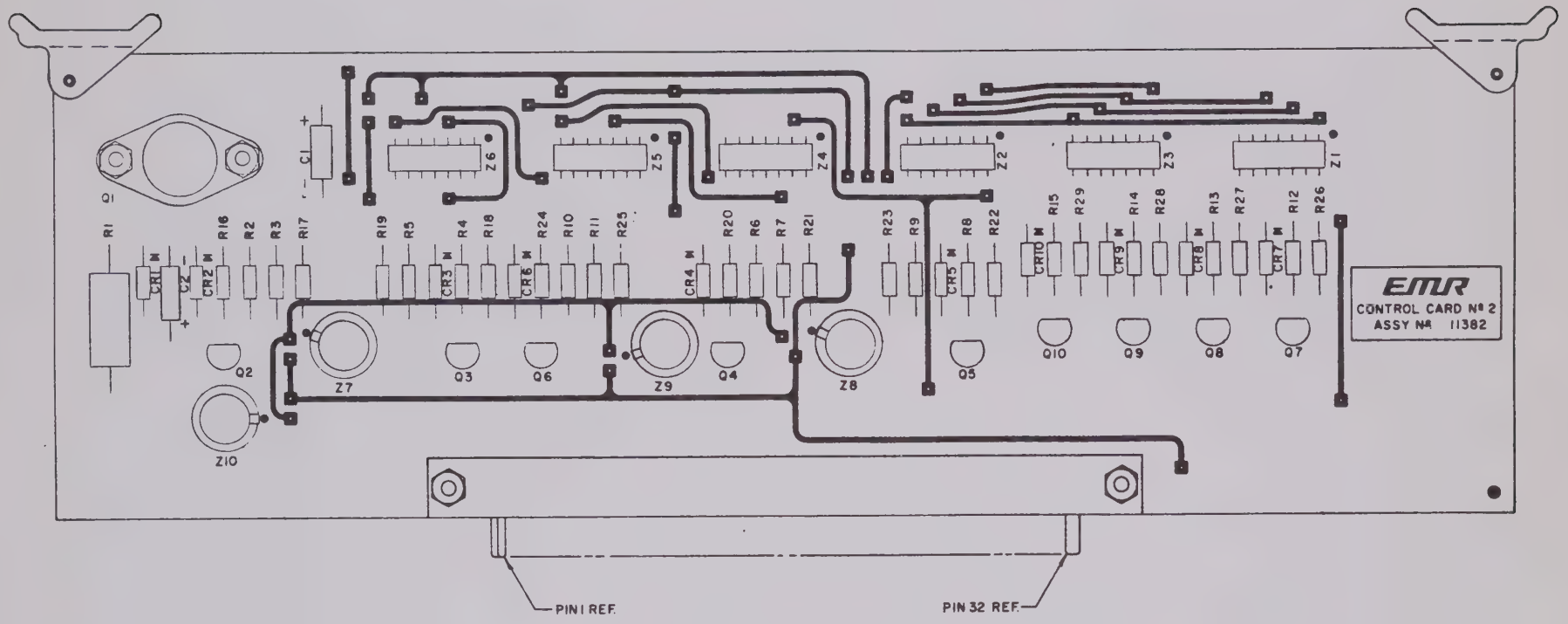


Figure 4-31. Control Card No. 2 (Sheet 2 of 2)

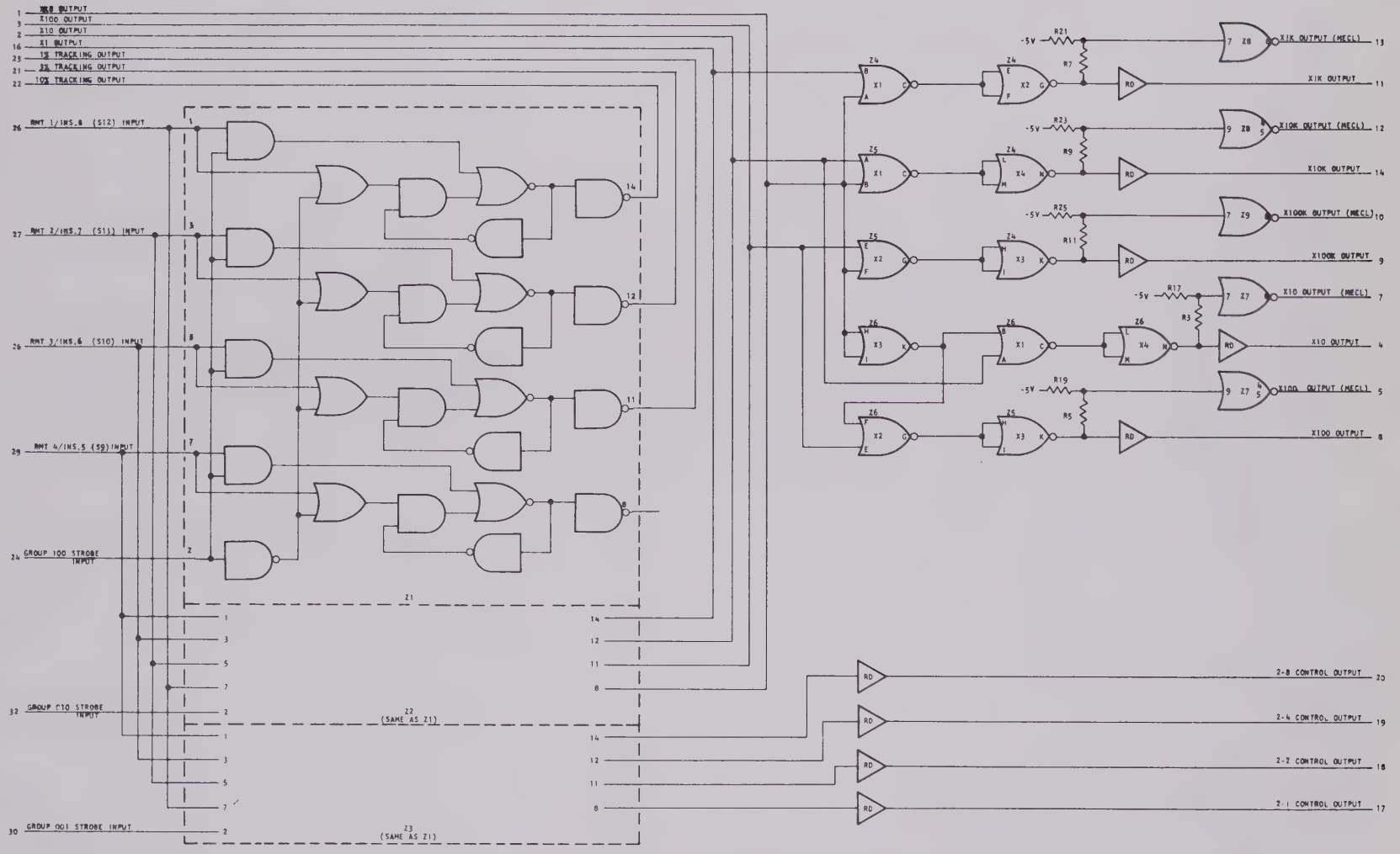


Figure 4-32. Control Card No. 2, Logic Diagram

Control card no. 2 performs the following functions: stores and controls the X1, X10, X100 XKB multipliers of the bit rate and the 1, 3, and 10 percent loop tracking parameters.

Storage register modules Z1 through Z3 are identical with module Z5 described under paragraph 4.3.16. The outputs of modules Z1 through Z3 are routed through NOR gates and relay drivers and to the phase lock loop circuits in the Model 2721.

4.3.18 Control Card No. 3 (Ref. Figures 4-33 and 4-34)

The control card no. 3 printed-wiring board (assembly no. 11380) is located in the card-file subassembly (A2) card slot 19 (J19). Integrated circuits and discrete components are used for all printed-wiring-board circuitry.

Control card no. 3 performs the following functions:

a. Stores and controls all eight input code parameters (NRZC, NRZM, NRZS, SØC, SØM, SØC, RZ, BP).

b. Receives the RI (reset integrator) control input from Control Card No. 4.

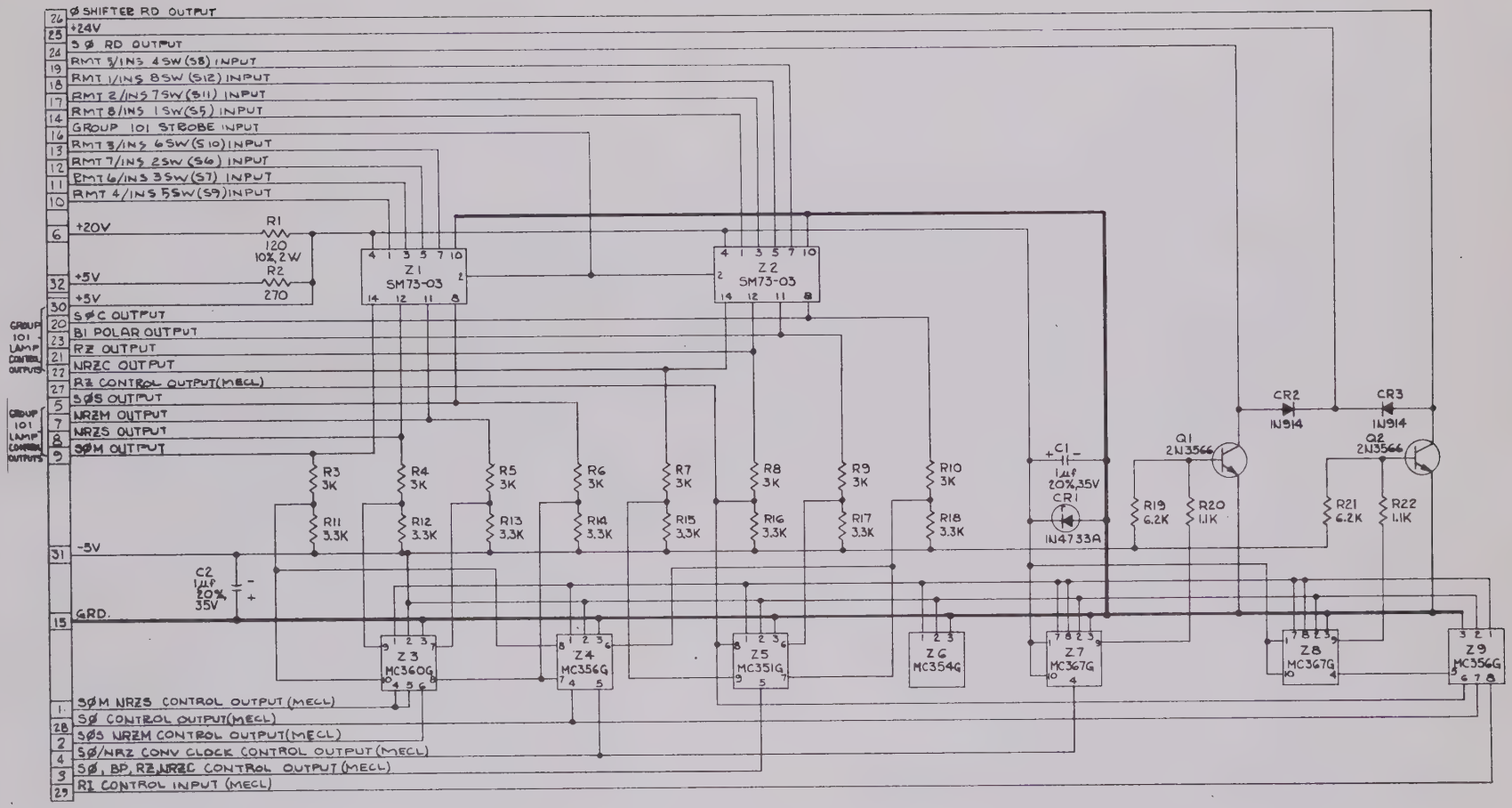
Storage register modules Z1 and Z2 are identical with module Z5 described under paragraph 4.3.16. The outputs of modules Z1 and Z2 are routed through NOR gates and relay drivers to functions within the Model 2721.

4.3.19 Control Card No. 4 (Ref. Figures 4-35 and 4-36)

The control card no. 4 printed-wiring board (assembly no. 11378) is located in the card-file subassembly (A2) in card slot 20 (J20). Integrated circuits and discrete components are used for all printed-wiring-board circuitry.

Control card no. 4 performs the following functions: stores and controls the polarity (N, I) detector (S, FS, RI) record output (NRZC, NRZM, SØC) and loop width (.3, 1, 3, AUX) parameters.

Storage register modules Z1 through Z3 are identical with module Z5 described under paragraph 4.3.16. The outputs of modules Z1 through Z3 are routed through NOR gates and relay drivers, and to other functions within the Model 2721.



NOTE

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4W.
2. DIODE TYPE 1N914 CONTROLLED BY EME DWG 636.

Figure 4-33. Control Card No. 3 (Sheet 1 of 2)

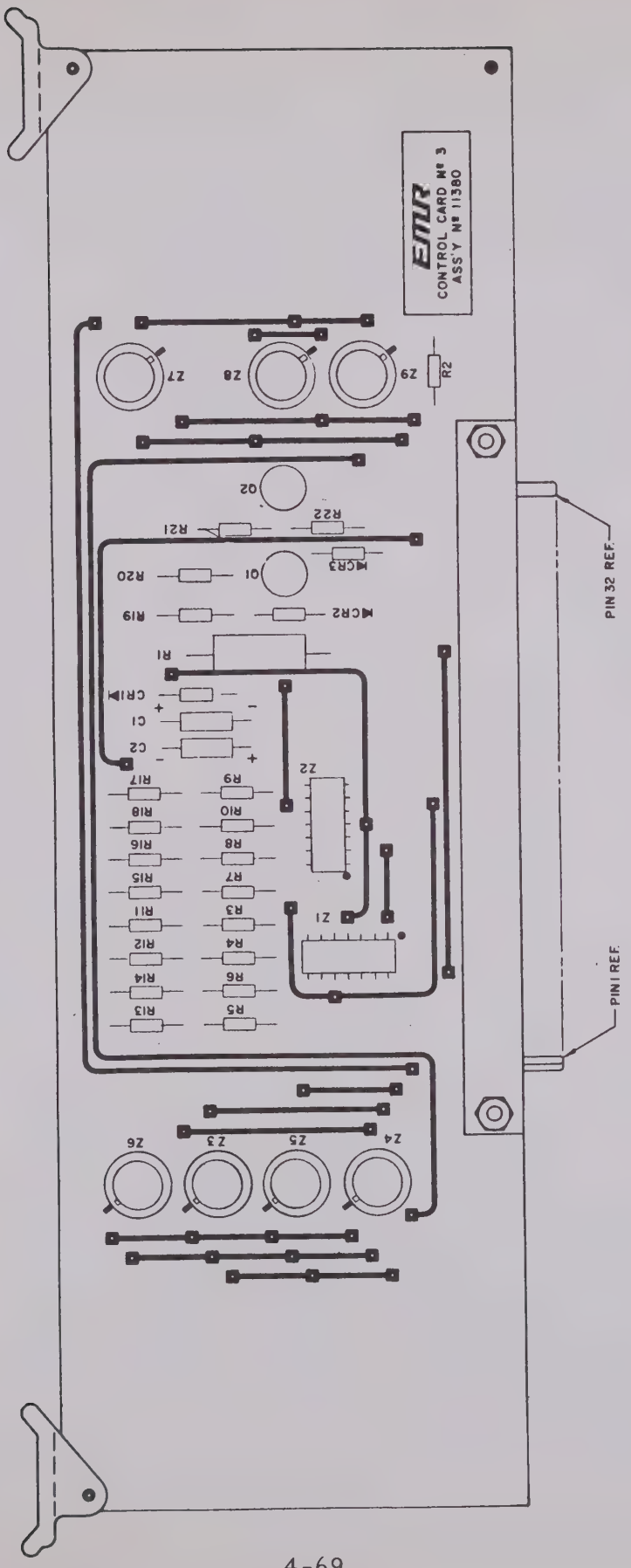


Figure 4-33. Control Card No. 3 (Sheet 2 of 2)

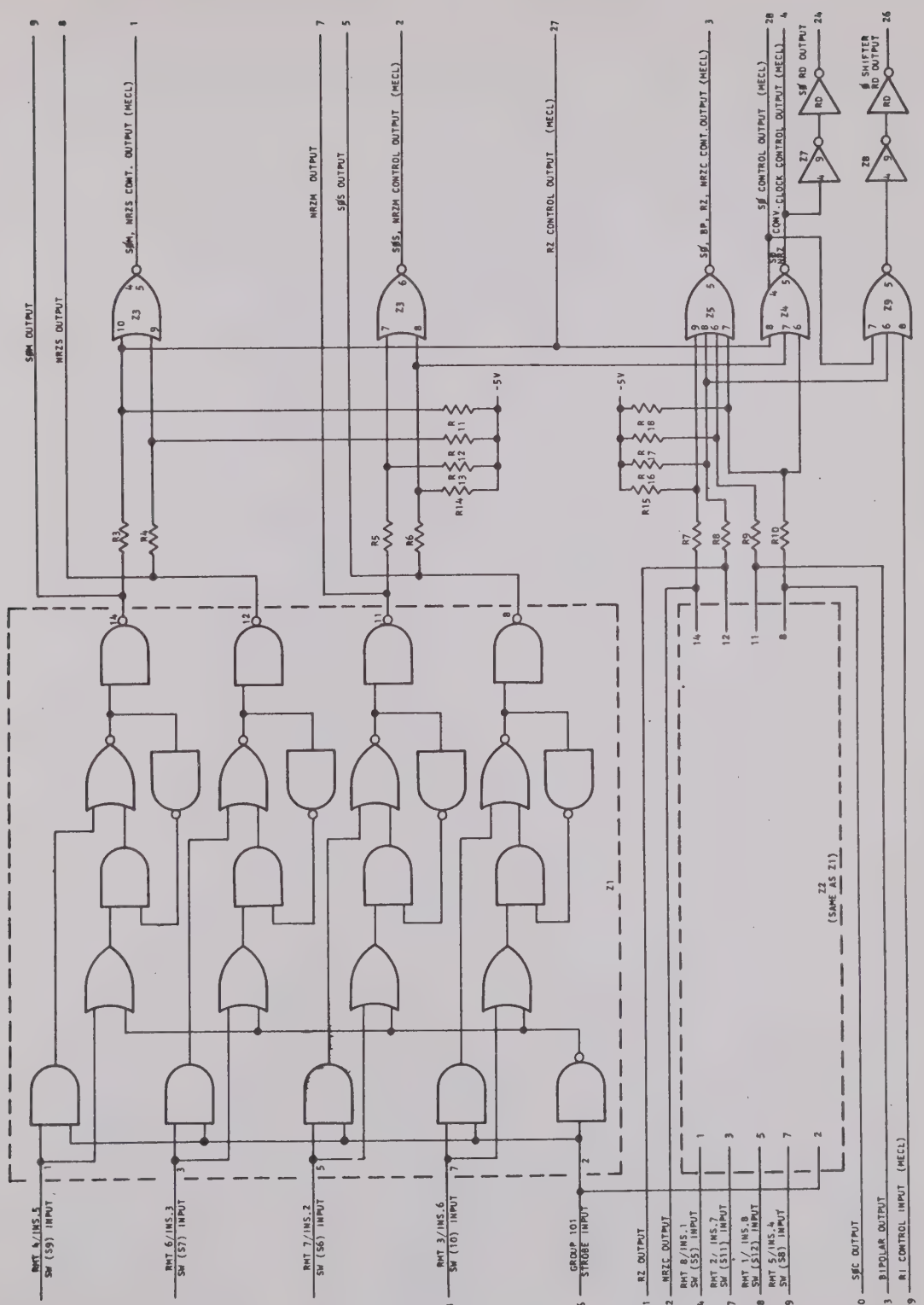
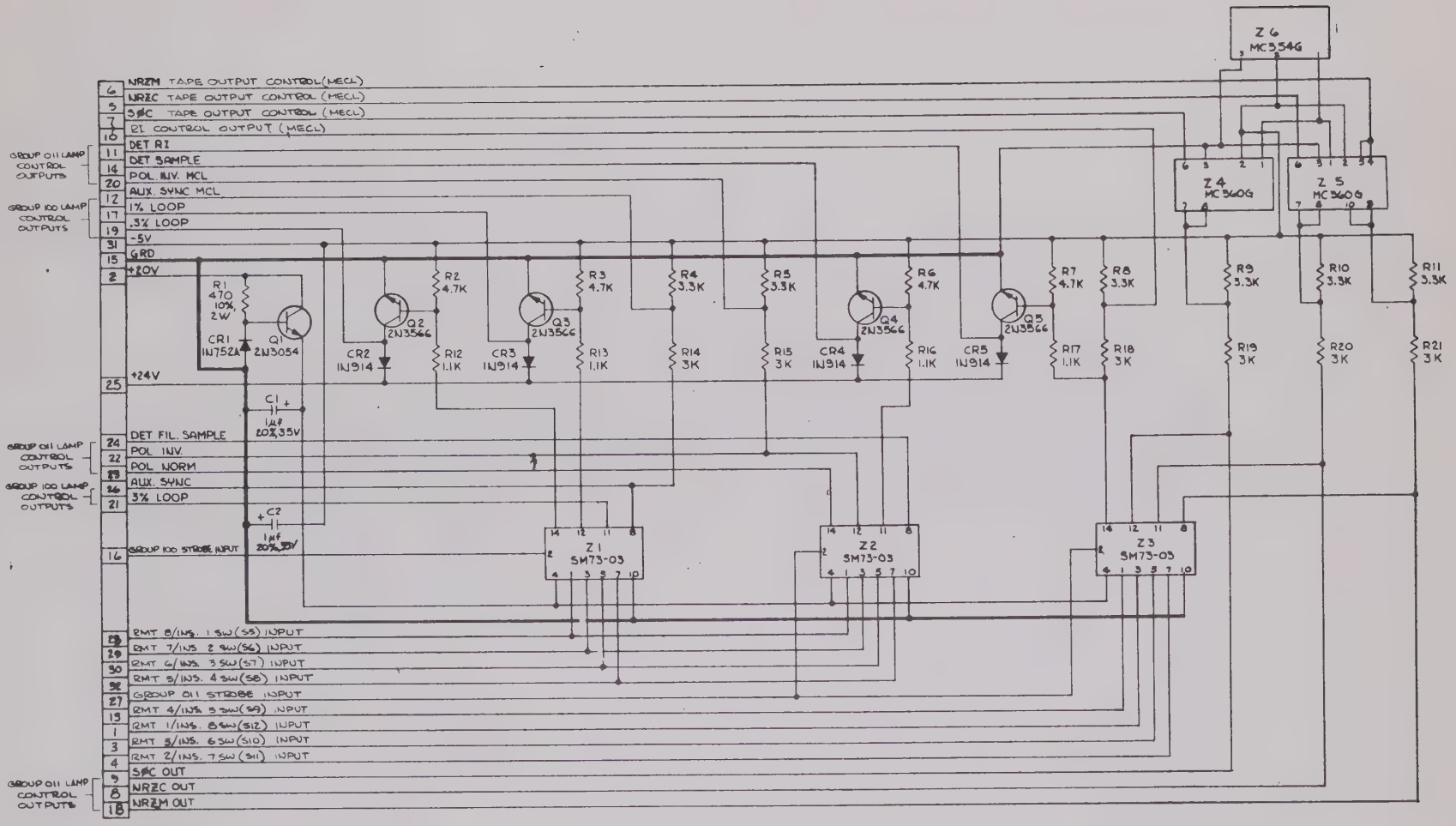


Figure 4-34. Control Card No. 3, Logic Diagram



NOTE

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS (K=1000), 5%, 1/4 W.
2. ALL DIODES ARE TYPE IN914 CONTROLLED BY EMR DWG 636
3. DIODE TYPE IN752A CONTROLLED BY EMR DWG 642.

Figure 4-35. Control Card No. 4 (Sheet 1 of 2)

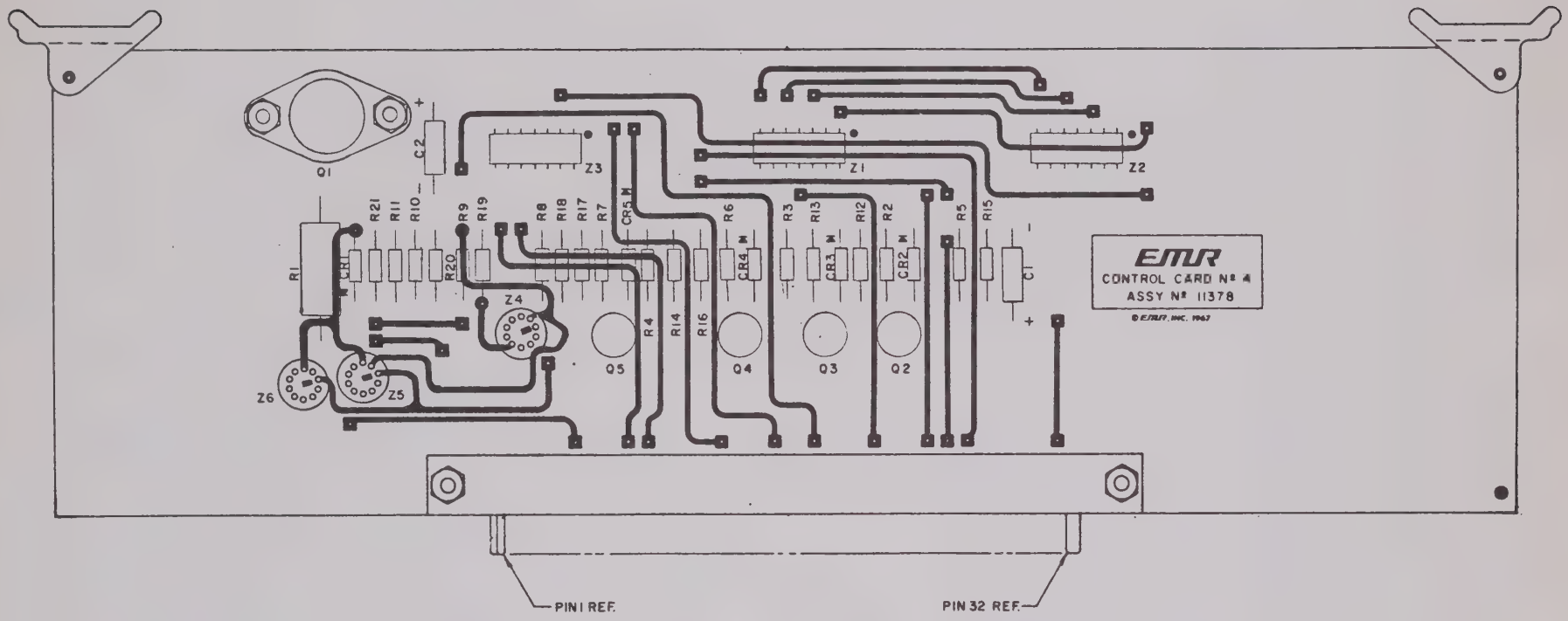


Figure 4-35. Control Card No. 4 (Sheet 2 of 2)

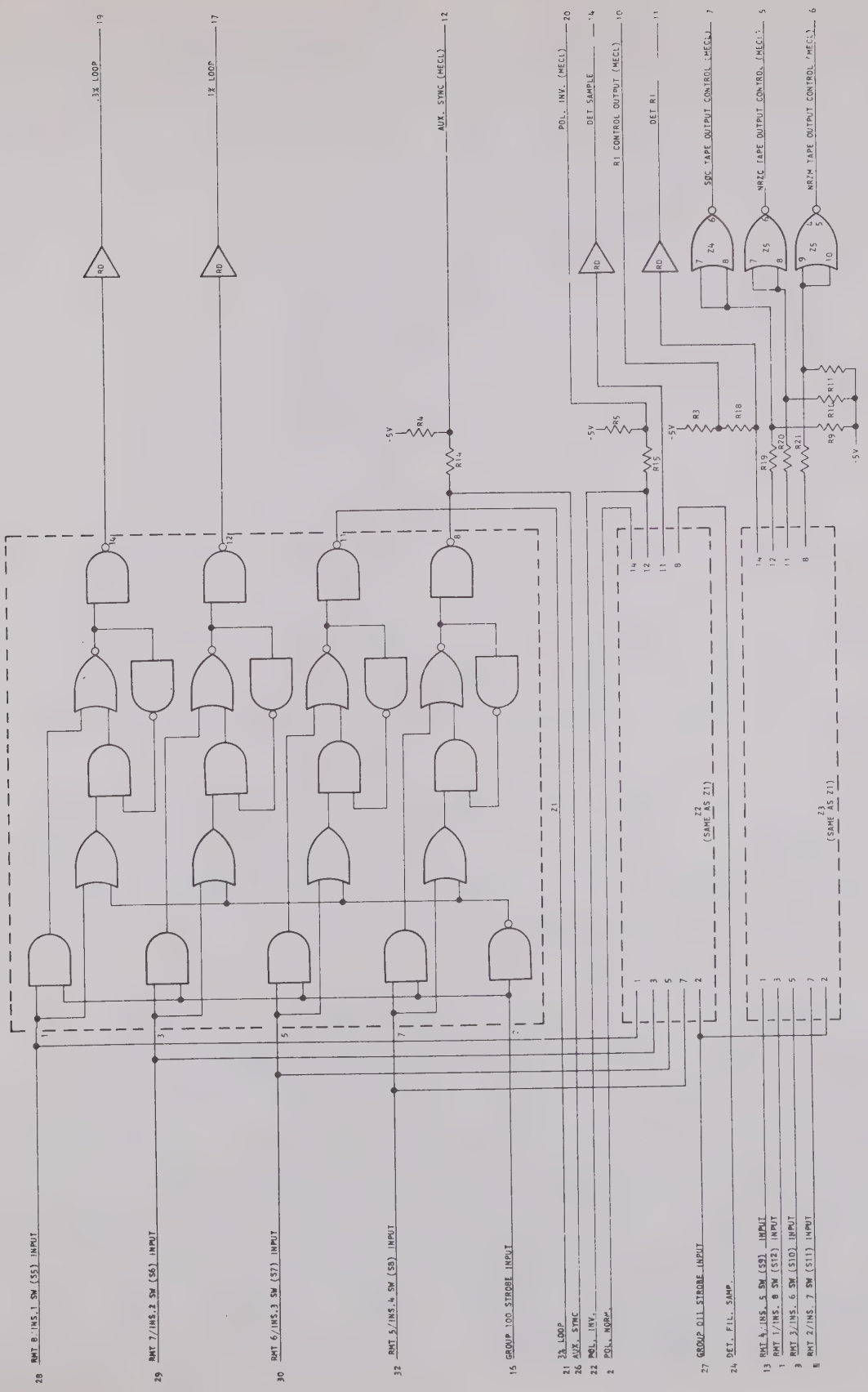


Figure 4-36. Control Card No. 4, Logic Diagram

4.3.20 Power Supply and Regulator (Ref. Figures 4-37 and 4-38)

All internal voltages required in the Model 2721 are generated by the power supply (assembly A3) and regulator (assembly no. 13163). Discrete components are used for all power supply and regulator circuitry. All power supply components are located in the power supply assembly except for the following:

a. FAN--Located on the rear-panel assembly (A4).

b. FUSE (F1)--Located on the rear-panel assembly (A4).

c. Power Connector--Located on the rear-panel assembly (A4).

d. Power Switch--Located on the front-panel assembly (A1).

e. Power Light--Part of the power switch assembly.

The regulator printed-wiring-board assembly is located in the card-file subassembly (A2) card slot 21 (J21).

The power supply receives a single phase, AC voltage through the rear-panel POWER connector (J10). The AC voltage is applied to the primary of the power supply transformer (T1) through a POWER switch (S3) located on the front panel. The blower fan (B1) is driven by the AC voltage. A fuse (F1) is provided to protect the blower and the power supply transformer primary from overloads.

The secondary of the power supply transformer (T1) is composed of four separate windings. Each secondary winding drives a full-wave bridge rectifier. The rectifiers are each provided with a capacitor and resistor for noise filtering. Three of the full-wave bridge rectifiers (CR1, CR2, and CR3) are used to drive regulators (-5.2V DC, +20V DC, and -20V DC, respectively). The fourth full-wave bridge rectifier (CR4) provides an unregulated +24V DC.

Since the regulators are similar in operation, only the +20V DC regulator will be discussed in this text. The full-wave bridge rectifier output (CR2) is applied to the +20V DC regulator through pins 5 and 26 of the regulator printed-wiring board. The +20V DC regulator is composed of a constant-current circuit (Q7, Q8), differential amplifier (Q11, Q12), voltage amplifier (Q10), and a series-regulator circuit (Q9 on the regulator printed-wiring board and Q2 in the power supply). Variations in the regulated +20V DC output are detected by differential amplifier Q11, Q12. Zener diode CR4 establishes the reference for the differential amplifier. The resultant output at the collector of Q11 is applied through Q10 to the series-limiting driver (Q9). A second current source for the base of the series-limiting driver (Q9) is provided by the constant-current circuit (Q7, Q8). The reference for this circuit is established by zener diode CR2. The amount of current available from the constant-current circuit (Q7, Q8) is dependent on the operational state of Q8. Q8 is biased by two factors, the

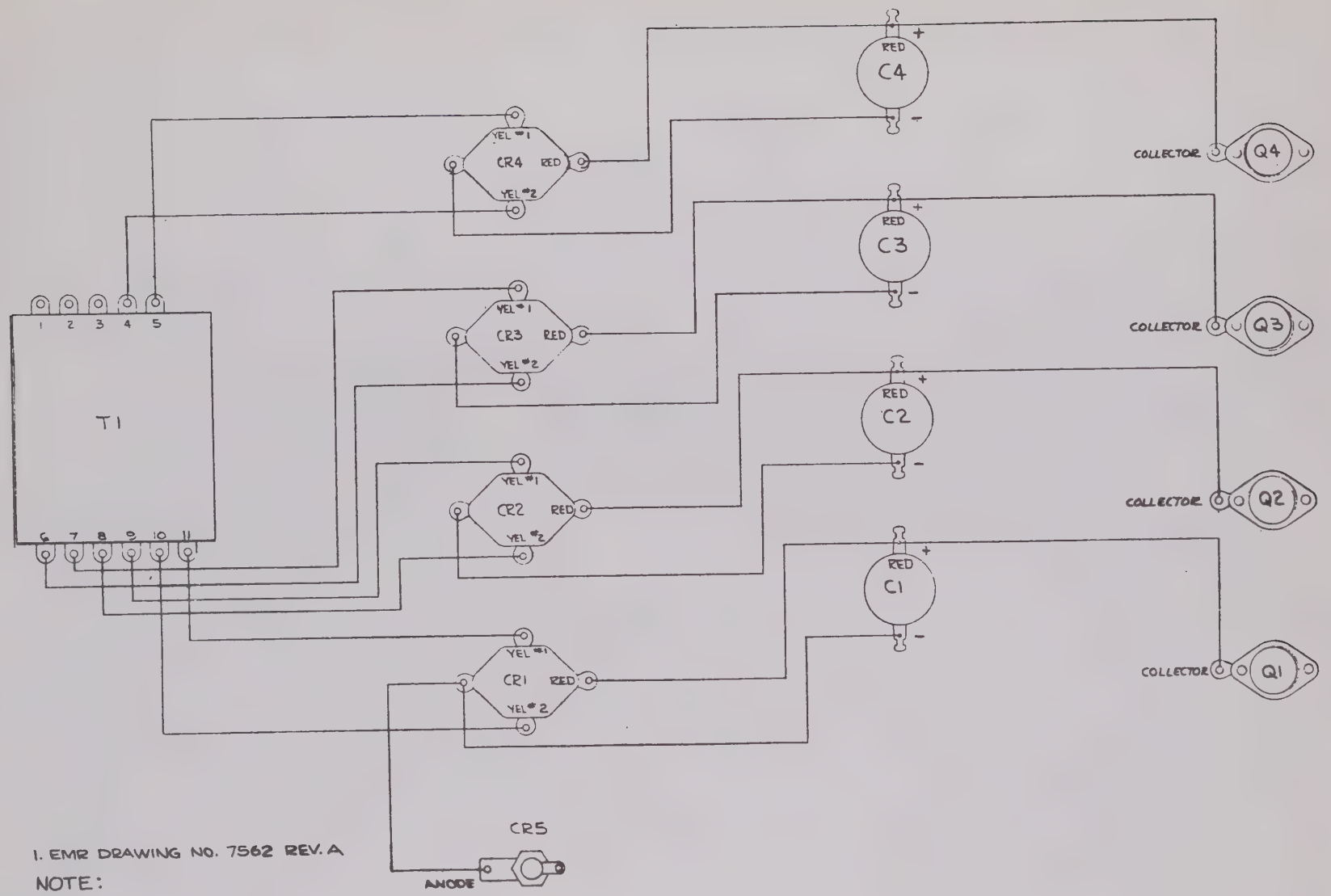
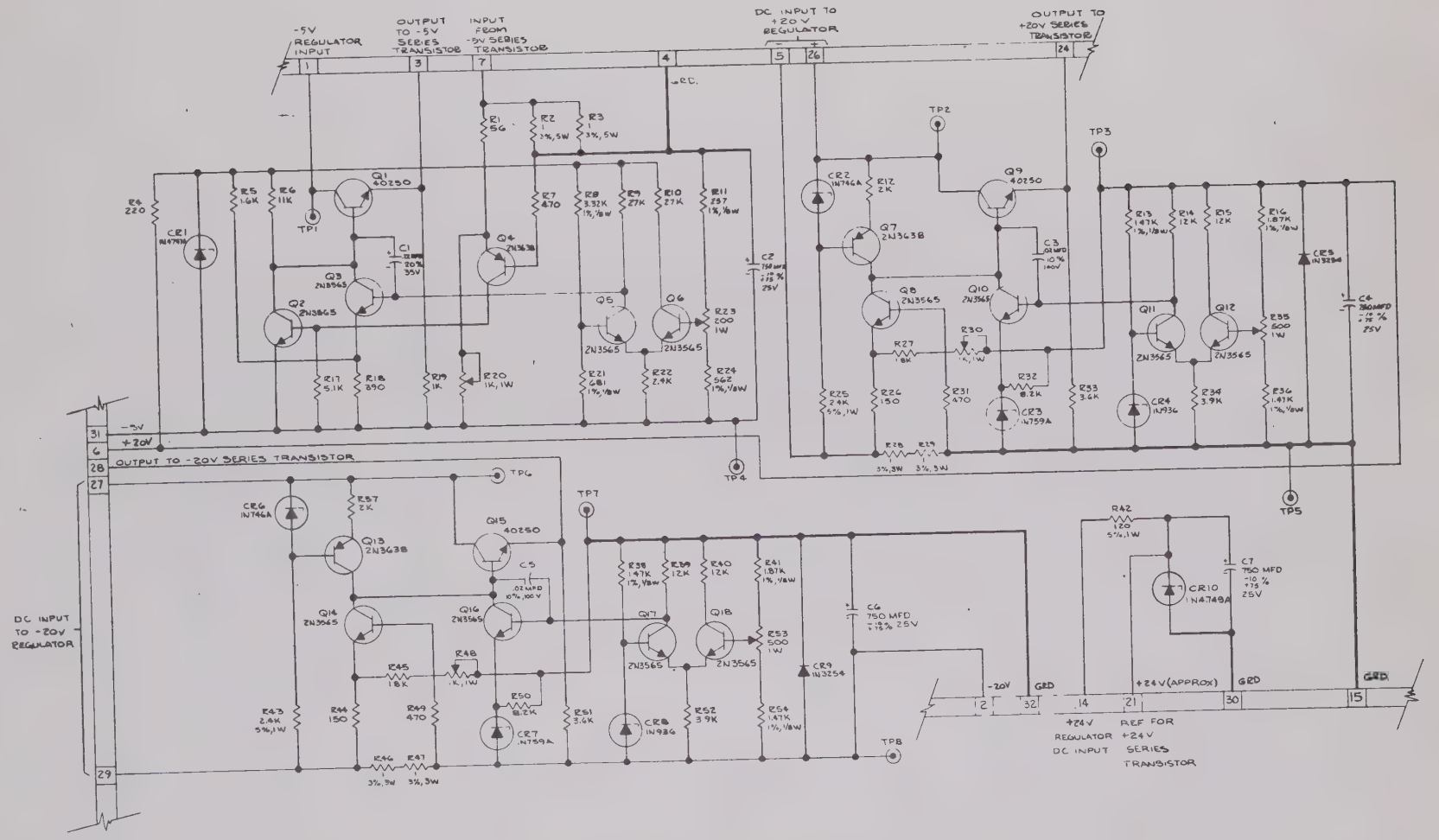


Figure 4-37. Power Supply, Wiring Diagram



NOTES:

(UNLESS OTHERWISE SPECIFIED)

1. ALL RESISTOR VALUE ARE IN OHMS (K=1000) ±5%, ¼ WATT.
2. ALL CAPACITOR VALUE ARE IN PICOFARADS ±5%, 500 VOLTS.

Figure 4-38. Regulator (Sheet 1 of 2)

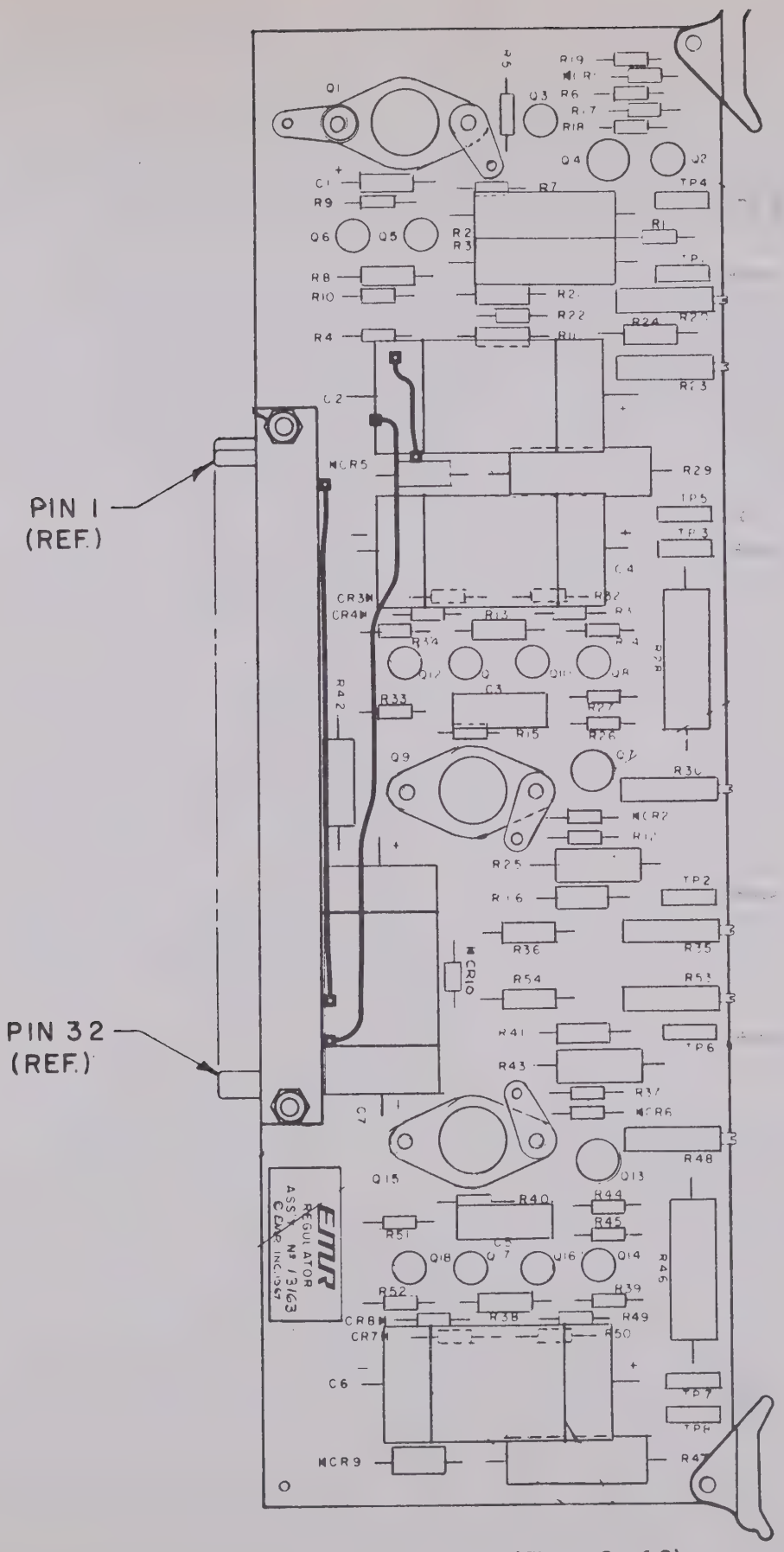


Figure 4-38. Regulator (Sheet 2 of 2)

amount of current flowing through R28, R29 (base bias) and the emitter voltage (emitter bias) supplied by the manually adjustable (R30) voltage divider (R26, R27, and R30). The amount of base drive available to the series-limiting driver (Q9) is the sum of the differential circuit output (Q11, Q12) and the constant-current circuit output (Q7, Q8).

The output of the series limiting driver (Q9) is applied to the series limiting transistor (Q2 in the power supply) through pin 24 of the regulator printed-wiring board. Due to the required heat dissipation, the series-limiting transistor (Q2) is mounted on a heat sink in the power supply. The emitter of the series limiting transistor (Q2) is applied to the regulator through pin 6 (+20V DC regulator output) on the regulator printed-wiring board. Two manual adjustments are provided in the regulator: current (R30) and voltage (R35).

The unregulated +24V DC supply is composed of a full-wave bridge rectifier (CR4, power supply), filter circuit (C4, R4, power supply), ripple filter circuit (R42, R55, C7, regulator printed-wiring board) and a current-limiting transistor (Q4, power supply).

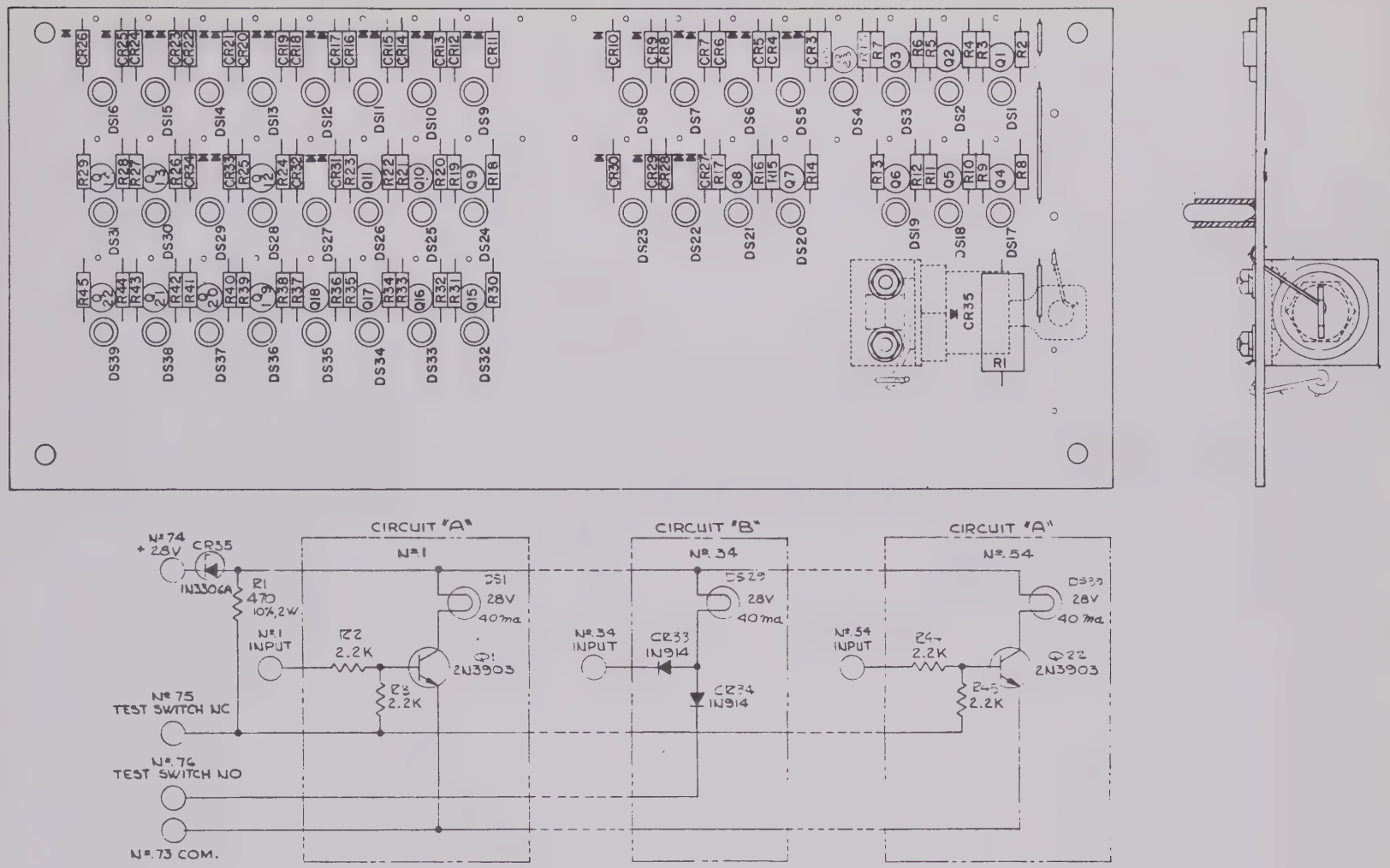
4.3.21 Assembly AIAI Display Card (Ref. Figure 4-39)

The display card is a printed circuit card with locations for 12 indicator circuits. The card is mounted on the rear of front panel assembly A1. The indicator circuits illuminate the amber lenses in the front panel. (See Figure 3-3)

Refer to the schematic in the lower half of Figure 4-39. The functional signals and front-panel TEST switch signal are ORed to operate the indicators. The 'B' type circuits are operated by relay drivers on the control cards 1 through 4 (refer to paragraphs 4.3.16 through 4.3.19).

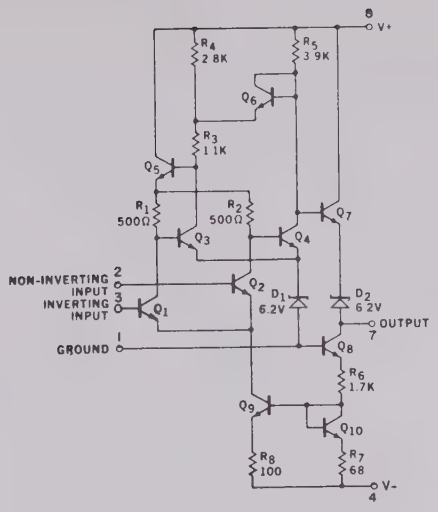
4.3.22 Integrated-Circuit Module Description

Figures 4-40 through 4-47 illustrate the eight different types of integrated circuits used in the Model 2721.



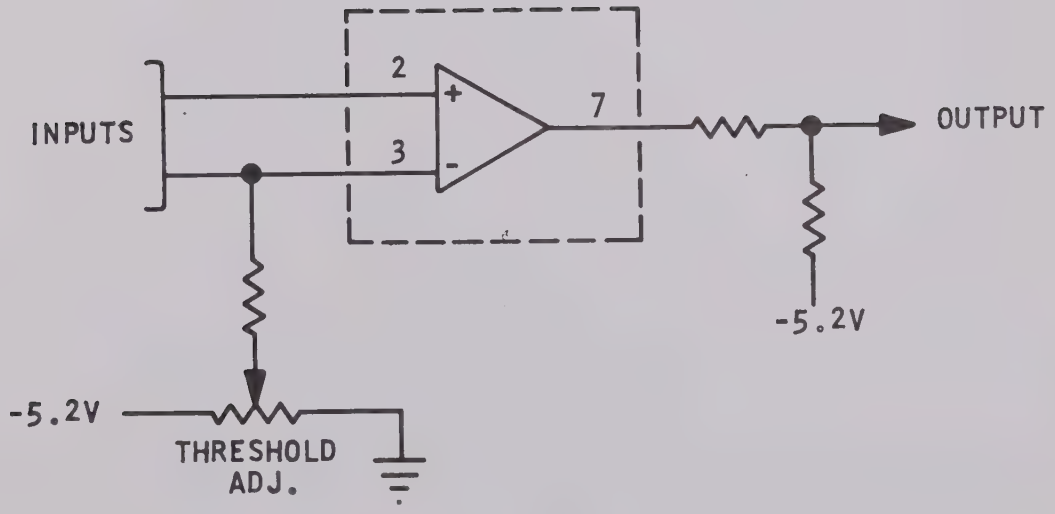
POSITION CHART	
CIRCUIT	POSITION
CIRCUIT "A"	1, 2, 3, 4, 19, 20, 21, 23, 24, 29, 30, 31, 33, 35, 36 & 47 THRU 54.
CIRCUIT "B"	5 THRU 8, 11 THRU 18, 25, 26, 32 & 34.
NO CIRCUIT USED	9, 10, 22, 27, 28, 37 THRU 46 & 55 THRU 72.

Figure 4-39. Assembly AIAI, Display Card



1--GRD
4-- -5.2V
8-- +

SCHEMATIC DIAGRAM



CIRCUIT CONFIGURATION

Figure 4-40. High-Speed Differential Comparator Integrated Circuit (μA710)

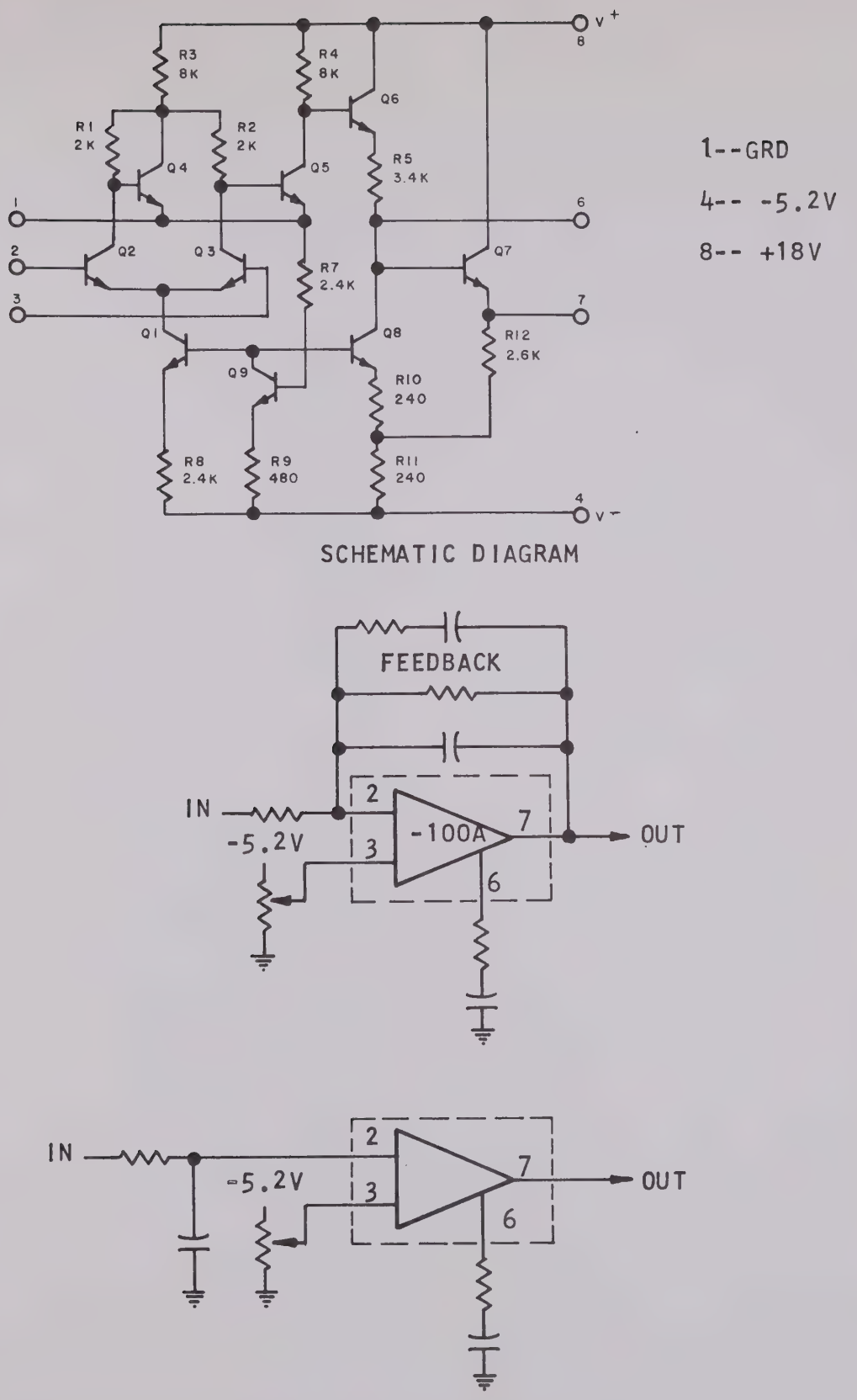
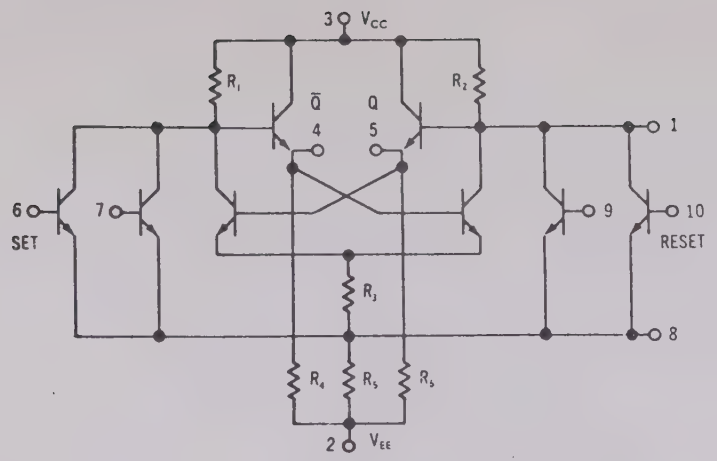


Figure 4-41. Wide-Band DC Amplifier Integrated-Circuit Module (μA712)



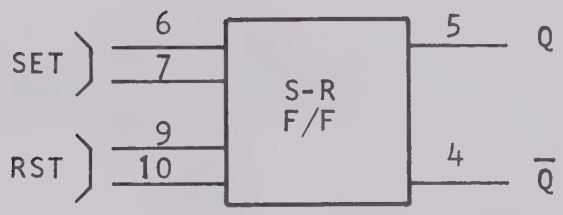
SCHEMATIC DIAGRAM

V_{CC}--GRD

V_{EE}-- -5.2V

1--(NOT USED)

8--(NOT USED)



LOGIC DIAGRAM

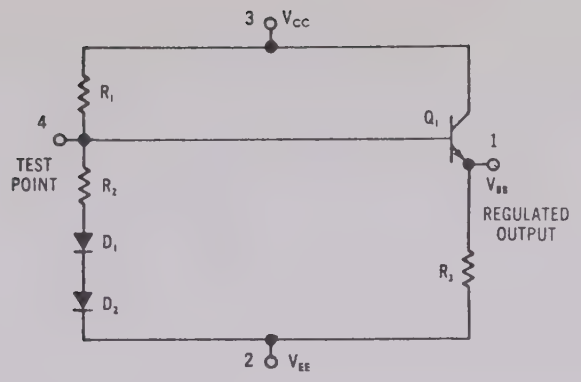
TRUTH TABLE

S	R	Q	$\bar{Q}$
1	0	1	0
0	1	0	1
0	0	*	*
1	1	**	**

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

*NO CHANGE FROM PREVIOUS STATE
**INDETERMINATE

Figure 4-42. DC Set/Reset Flip-Flop Integrated-Circuit Module (MC352G)



SCHEMATIC DIAGRAM

CIRCUIT FUNCTION

THE MC354G MODULE OPERATES AS A TEMPERATURE-COMPENSATING REGULATOR USED WITH THE MC350-SERIES INTEGRATED-CIRCUIT MODULES.

CIRCUIT DESCRIPTION

THE DIVIDER NETWORK R_1, R_2, D_1, D_2 COMPENSATES FOR TEMPERATURE VARIATIONS OF THE BASE-EMITTER VOLTAGES OF Q_1 AND OF THE DRIVEN GATES, PRODUCING A BIAS VOLTAGE FOR THE ASSOCIATED LOGIC CIRCUITS THAT MAINTAINS A CONSTANT SET OF DC OPERATING CONDITIONS OVER THE TEMPERATURE RANGE OF 0 TO +75°C. IN ADDITION, COMPENSATION FOR POWER-SUPPLY VARIATIONS IS ACHIEVED, SINCE THE BIAS OUTPUT VOLTAGE IS DERIVED FROM THE SYSTEM SUPPLY.

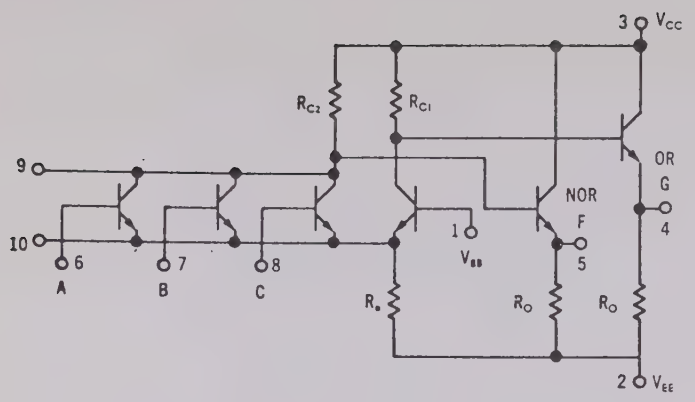
THE BIAS DRIVER TERMINAL VOLTAGES ARE AS FOLLOWS:

V_{CC}--0 VOLT (SIGNAL GROUND)

V_{EE}-- -5.2 VOLTS (POWER-SUPPLY INPUT)

V_{BB}-- -1.15 VOLTS (NOMINAL OUTPUT AT 25°C)

Figure 4-43. Bias Driver Integrated-Circuit Module (MC354G)

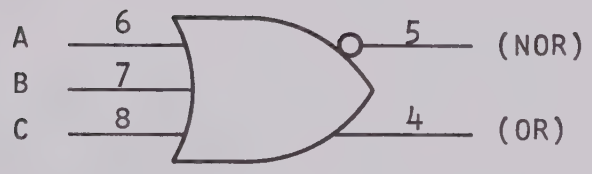


V_{CC}--GROUND

V_{BB}-- -1.15V

V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



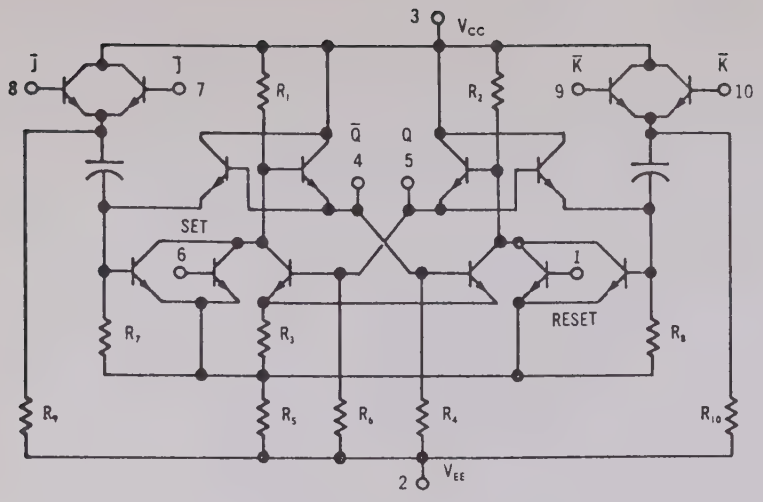
LOGIC DIAGRAM

TRUTH TABLE

A	B	C	OR	NOR
0	0	0	0	1
1	0	0	1	0
0	1	0	1	0
0	0	1	1	0
1	1	1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

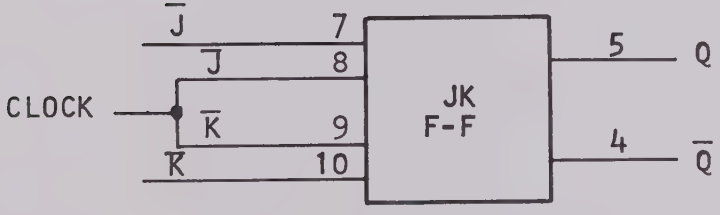
Figure 4-44. Three-Input OR/NOR Integrated-Circuit Module (MC356G)



SCHEMATIC DIAGRAM

V_{CC}--GRD

V_{EE}-- -5.2V



LOGIC DIAGRAM

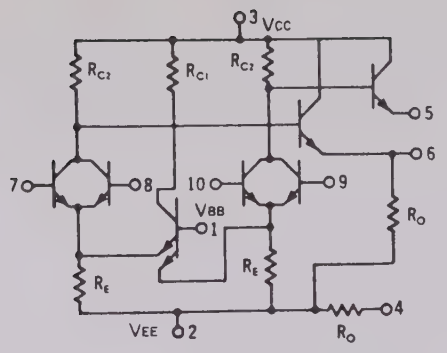
TRUTH TABLE

CLOCK	$\overline{J}$	$\overline{K}$	Q	$\overline{Q}$
1	1	0	0	1
1	0	1	1	0
1	0	0	*	*
1	1	1	**	**

*CHANGES FROM PREVIOUS STATE.
** NO CHANGE FROM PREVIOUS STATE.

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

Figure 4-45. JK Flip-Flop Integrated-Circuit Module (MC358G)

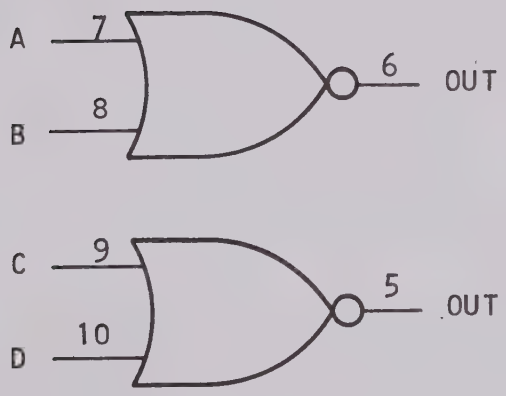


V_{CC}--GRD

V_{BB}-- -1.15V

V_{EE}-- -5.2V

SCHEMATIC DIAGRAM



LOGIC DIAGRAM

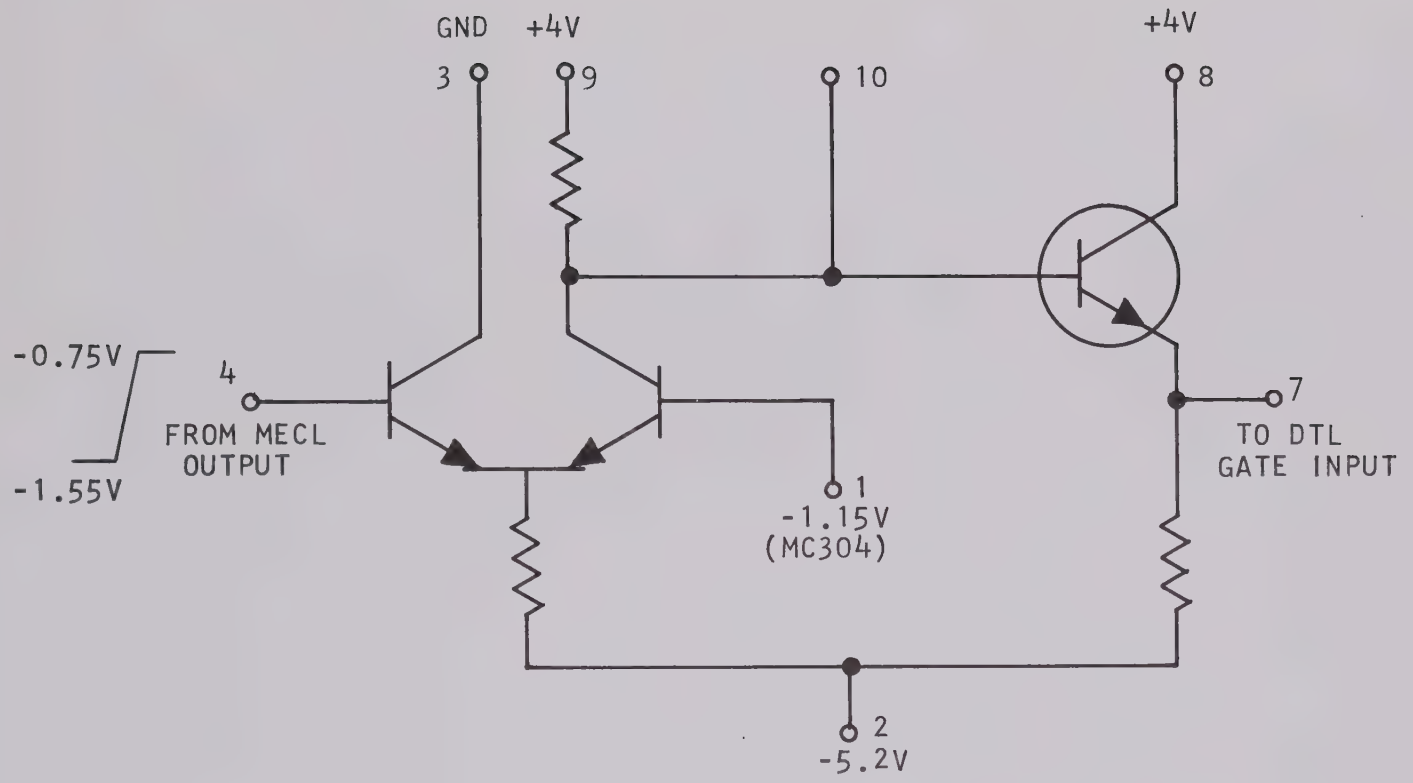
TRUTH TABLE

7*	8**	OUT
0	0	1
1	0	0
0	1	0
1	1	0

LOGIC LEVELS
1 = -0.7V 0 = -1.5V

*A OR C
**B OR D

Figure 4-46. Dual NOR Integrated-Circuit Module (MC360G)



NOMINAL LOGIC LEVELS:	-55°C	25°C	+125°C
LOGICAL "1"	+2.810V	+2.950V	+3.130V
LOGICAL "0"	-0.530V	-0.700V	-0.910V

Figure 4-47. Level Translator (MC 1512)

SECTION 5

MAINTENANCE

5.1 GENERAL

This section contains troubleshooting and maintenance information for the Model 2721 intended for use in conjunction with the theory of operation contained in Section 4, and a wire list shown in Table 5-2.

In the event of a malfunction, the following general method of troubleshooting and repairing is recommended:

a. Perform a visual inspection in accordance with paragraph 5.2.

b. Perform test procedures in accordance with paragraph 5.3 to aid in isolating the malfunction.

c. After isolating a malfunction to a particular circuit card proceed with normal troubleshooting techniques to locate the defective component using the appropriate schematic diagram, in paragraph 4.3, The physical location of components shown in the card layout drawing accompanying the appropriate schematic.

d. Refer to Section 6 for component descriptions and identification information.

5.2 INSPECTION

The Model 2721 should be subjected to regular periodic inspections to ensure continued proper operation. The following inspection is recommended as a means of preventive maintenance and as an aid in isolating malfunctions.

a. Inspect chassis and card connectors for signs of damage.

b. Inspect wiring for loose or broken connections.

c. Inspect printed-wiring boards for physical damage and component discoloration caused by overheating.

d. Ensure that all printed-wiring boards are firmly seated.

e. Inspect power supply assembly for physical damage and component discoloration caused by overheating.

f. Inspect air intake and exhaust grills and the blower for dust, dirt, or any foreign matter which may impede air flow.

CAUTION

Serious damage to the unit may result if the air flow is impeded.

5.3 TEST PROCEDURES

The following test procedures are provided as an aid in localizing trouble or a defective component in the Model 2721.

5.3.1 Power Supply Assembly (See Figure 4-38)

a. Apply power to the Model 2721.

b. Ensure that the blower is operating.

c. Using a digital voltmeter, check to ensure that all output voltages at the test points specified in table 5-1 are within the specified tolerances.

CAUTION

A critical balance exists between the +20V DC and -20V DC regulated voltages. The two voltages must be equal in amplitude.

Table 5-1. Power Supply Voltage Limits

VOLTAGE (Note 1)	TEST POINT	ACCEPTABLE LIMITS
-5.2	A2J21TP4	-5.0 to -5.4
+20	A2J21TP3	+19.8 to +20.2
-20	A2J21TP8	-19.8 to -20.2
+24	(Note 2)	Unregulated

Notes:

1. All voltages referenced to signal ground (A2J21TP5).

2. Illumination of any front-panel display light indicates presence of unregulated +24V DC.

5.3.2 Functional Assembly Tests

The following tests are to be done in sequential order. An oscilloscope and a frequency counter are required. Set up the Model 2721 for the following conditions before beginning the tests:

code: SØC (use Figure 3-8 as a guide)

input level: 1 volt peak-to-peak

bit rate: 100K bits/second unless otherwise specified (use Figures 3-4 and 3-5 as a guide)

bit pattern: 10101010----or other repetitive pattern

Then proceed as indicated below.

5.3.2.1 Input Amplifier (See Figure 4-3)

a. Remove top and bottom covers of Model 2721.

b. Program filter sample (FS) detection (use Figure 3-6 as a guide.

c. Connect oscilloscope probe to A2J1 pin 32.

d. Adjust R41 and check for signal balanced about ground.

e. Replace bottom cover of Model 2721.

5.3.2.2 Split-Phase-To-NRZ Converter (See Figure 4-4)

a. Connect oscilloscope probe to TP1.

b. Adjust R41 for signal balanced about ground.

c. Connect oscilloscope probe to TP2.

d. Adjust R42 for signal balanced about ground.

e. Connect oscilloscope to TP3.

f. Adjust R43 for signal balanced about ground.

5.3.2.3 Bit-Rate Filter (See Figure 4-6)

a. Connect oscilloscope to TP1.

b. Adjust R30 for signal balanced about ground.

5.3.2.4 Bit-Rate/2 Filter (See Figure 4-8)

a. Connect oscilloscope to TP1.

b. Adjust R30 for signal balanced about ground.

5.3.2.5 Reset Integrator (See Figure 4-10) Card 4

a. Program reset integrator (RI) detection mode (use Figure 3-6 as a guide).

b. Connect oscilloscope to TP2.

c. Adjust R19 for signal balanced about ground.

d. Connect oscilloscope to TP3.

e. Adjust R21 for signal balanced about ground.

f. Connect oscilloscope to TP4.

g. Adjust R22 for signal balanced about ground.

5.3.2.6 Loop Resistor (See Figure 4-15) Card 10

a. Program a bit rate of 10K bits per second (use Figures 3-4 and 3-5 as a guide).

b. Connect a jumper between TP3 and TP4.

c. Adjust R58 until front-panel deviation (DEV) meter reads center scale.

d. Program a bit rate of 990K bits/second.

e. Leave jumper between TP3 and TP4.

f. Adjust R59 until front-panel deviation (DEV) meter reads center scale.

5.3.2.7 Voltage-Controlled Oscillator (See Figure 4-18)

a. Program a bit rate of 10K bits per second.

b. Connect frequency counter to SYNC jack on front panel.

c. Adjust R42 until counter reads 10.00 KHZ.

d. Remove jumper between TP3 and TP4 on Loop Resistor Assembly.

e. Leave counter connected to SYNC jack.

5.3.2.8 Loss of Lock and Counter

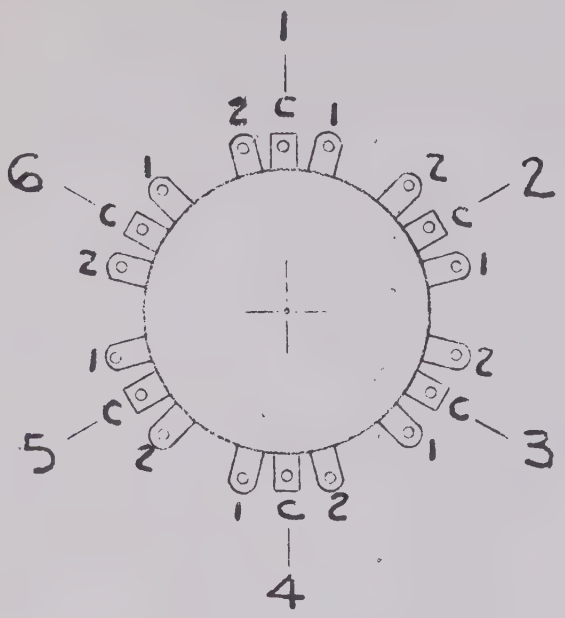
a. Slowly decrease input signal amplitude until loss of sync occurs.

b. Adjust R8 until front-panel SYNC indicator just lights.

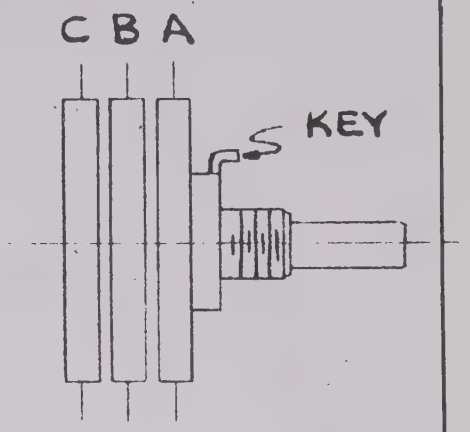
c. Remove counter.

d. Replace bottom cover of Model 2721.

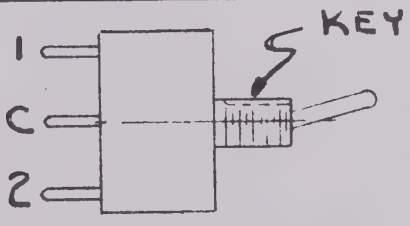
Table 5-2. Wiring Schedule (11157)



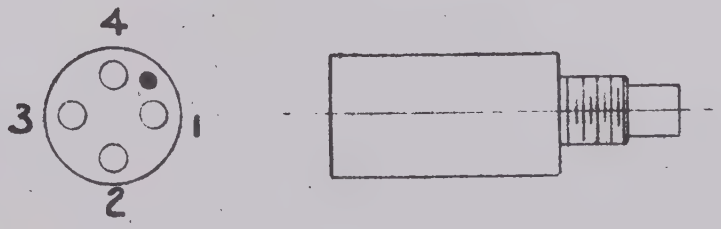
TYP FOR A, B & C



S1

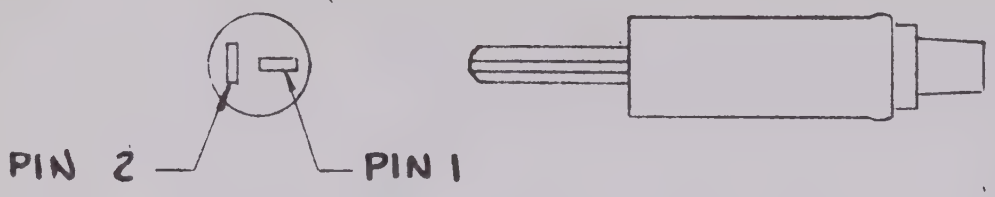


S5 THRU S15 INCL.

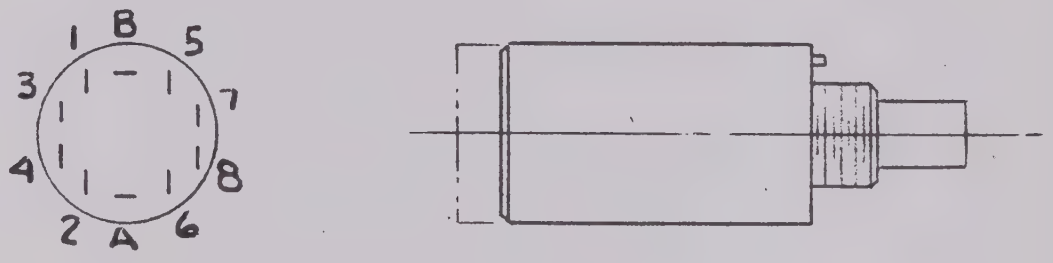


S2 & S4

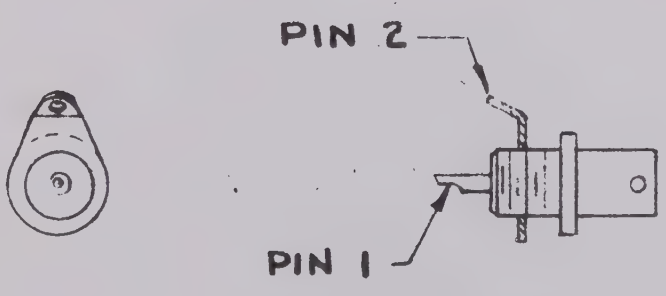
Table 5-2 (Cont'd.). Wiring Schedule (11157)



DS1, DS2 & DS3

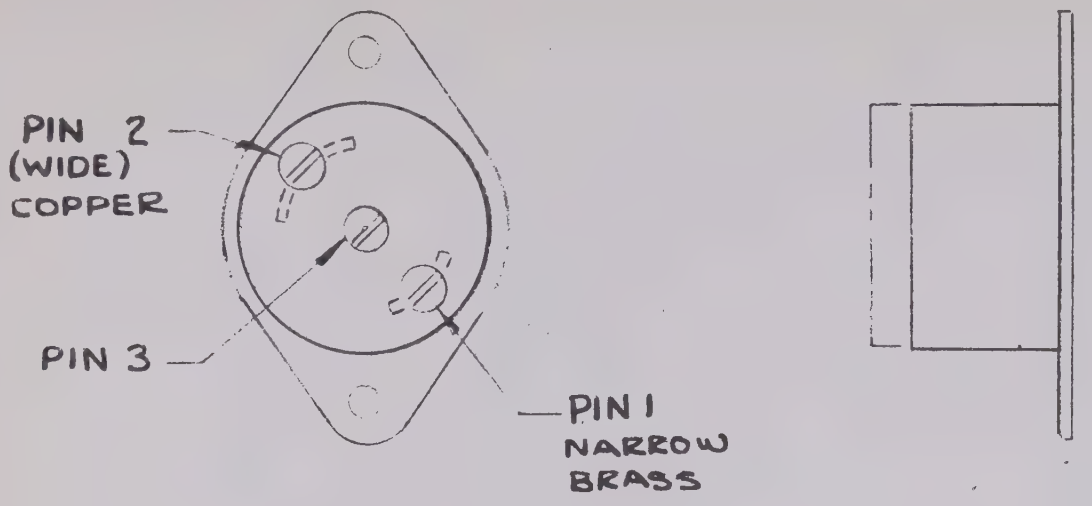


S3

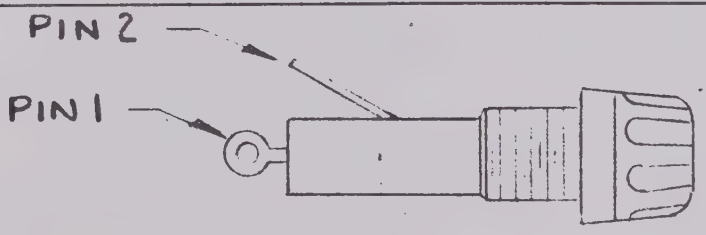


J2 THRU J9 INCL.

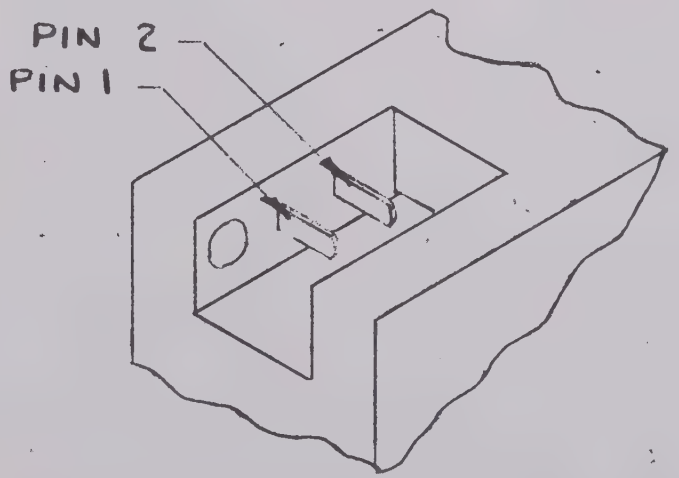
Table 5-2 (Cont'd.). Wiring Schedule (11157)



J10



F1



B1 (FOR BSC & -2 ONLY)

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J1P 1			A4J2P1
1			A1TP4
2			A2J2P2
3			A2J3P7
4			A2J3P8
5			A2J2P29
6			A2J2P6
7			A2J9P32
8			A2J7P3
9			A4J1PH5
10			A1M2+
10			A2J7P1
11			A4J1PG6
12			N/C
13			A1DS3P1
14			A1DS2P1
15			A2J2P15
15			A4J11P1
15			A1TP1
16			N/C
17			N/C
18			N/C
19			N/C
20			A1M2-
21			N/C
22			N/C
23			N/C
24			N/C
A2J1P 25			A2J2P25

FROM	TERM TYPE	ASSY CODE	TO
A2J1P 26			A2J2P10
27			A2J2P1
28			N/C
29			N/C
30			N/C
31			A2J2P31
A2J1P 32			A2J3P14
A2J1P 13			A4J1PC10
A2J1P 14			A4J1PD9

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J2P 1			A2J1P27	A2J2P25			A2J1P25
2			A2J3P2	26			N/C
2			A2J1P2	27			A2J7P4
3			N/C	28			N/C
4			N/C	29			A2J1P5
5			N/C	30			N/C
6			A2J3P6	31			A2J4P31
6			A2J1P6	A2J2P31			A2J1P31
7			N/C	A2J2P32			N/C
8			N/C				
9			N/C				
10			A2J3P1				
10			A2J1P26				
11			N/C				
12			N/C				
13			N/C				
14			N/C				
15			A2J3P15				
15			A2J1P15				
16			N/C				
17			N/C				
18			N/C				
19			N/C				
20			N/C				
21			A2J4P8				
22			N/C				
23			N/C				
24			N/C				
A2J2P25			A2J3P25				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J3P 1			A2J4P7	A2J3P 23			A2J4P23
1			A2J2P10	24			A2J4P26
2			A2J4P2	25			A2J4P25
2			A2J2P2	25			A2J2P25
3			A2J5P4	26			A2J4P21
4			A2J4P29	27			N/C
5			A2J6P11	28			N/C
6			A2J4P6	29			N/C
6			A2J2P6	30			A2J4P28
7			A2J4P4	31			N/C
7			A2J1P3	A2J3P 32			N/C
8			A2J4P3	A2J3P 25			A1DS1P2
8			A2J1P4				
9			A2J4P1				
10			A2J4P5				
11			A2J5P11				
12			N/C				
13			A2J4P13				
14			A2J5P3				
14			A2J1P32				
15			A2J4P15				
15			A2J2P15				
16			A2J6P12				
17			N/C				
18			N/C				
19			A2J4P14				
20			A2J4P20				
21			A2J4P21				
A2J3P 22			N/C				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J4P 1			A2 J5 P9	A2J4P 19			N/C
1			J3 P9	20			A2 J5P20
2			J5P2	20			J3P20
2			J3P2	21			J5P21
3			J5P8	21			J3P21
3			J3P8	22			J1P20
4			J5P7	23			J5P23
4			J3P7	23			A2 J3P23
5			J5P10	24			N/C
5			J3P10	25			A2 J5P25
6			J5P6	25			J3P25
6			J3P6	26			J5P24
7			J6P8	26			J3P24
7			J3P1	27			J5P26
8			J5P14	27			J3P26
8			A2 J2P21	28			J5P30
9			N/C	28			J3P30
10			N/C	29			J5P4
11			N/C	30			J1P8
12			N/C	31			J6P31
13			A2 J5P13	31			J2P31
13			J3P13	A2J4P 32			A2 J20P11
14			J5P19				
14			J3P19				
15			J5P15				
15			A2J3P15				
16			N/C				
17			N/C				
A2J4P 18			N/C				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J5P 1			A2 J20P14
2			J8P2
2			J4P2
3			J3P14
4			J6P13
4			A2 J3P3
5			N/C
6			A2 J6P6
6			J4P6
7			J6P3
7			J4P4
8			J6P1
8			J4P3
9			J6P4
9			J4P1
10			J6P5
10			J4P5
11			J6P7
11			A2 J3P11
12			N/C
13			A2 J6P14
13			J4P13
14			J4P8
15			J6P15
15			A2 J4P15
16			N/C
17			N/C
18			N/C
A2J5P 19			A2 J6P18

FROM	TERM TYPE	ASSY CODE	TO
A2J5P 19			A2 J4P14
20			J6P21
20			J4P20
21			J6P23
21			A2 J4P21
22			N/C
23			A2 J6P26
23			J4P23
24			J6P21
24			J4P26
25			J6P25
25			J4P25
26			J6P28
26			A2 J4P27
27			N/C
28			N/C
29			N/C
30			A2 J6P22
30			A2 J4P28
31			N/C
A2J5P 32			N/C

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J6P 1			A2 J11P17
1			A2 J5 P8
2			NIC
3			A2 J11P14
3			J5P7
4			J11P22
4			J5P9
5			J11P24
5			J5P10
6			J7P6
6			J5P6
7			J11P26
7			J5P11
8			J19P24
8			J4P7
9			J19P26
10			J7P10
11			J3P5
12			J3P16
13			J5P4
14			J10P7
14			J5P13
15			J7P15
15			J5P15
16			J14P30
16			J7P19
17			J14P3
18			J10P11
A2J6P 18			A2 J5P19

FROM	TERM TYPE	ASSY CODE	TO
A2J6P 19			A2 J14P5
20			J10P4
21			J10P18
21			J5P20
22			J10P29
22			J5P30
23			J10P21
23			J5P21
24			J10P3
25			J10P25
25			J5P25
26			J10P26
26			J5P23
27			J10P27
27			J5P24
28			J10P28
28			A2J5P26
29			A4J5P1
30			A2J20P12
31			J1P31
31			J4P31
A2J6P 32			A2J1P22

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J7P 1			A2 J9P9	A2J7P 23			N/C
1			A2 J1P10	24			A2 J8P3
2			N/C	25			N/C
3			A2 J8P9	26			A2 J19P3
3			J1P8	27			J8P7
4			J14P27	28			J9P7
4			J2P27	29			A2 J15P32
5			J20P6	30			N/C
6			J8P6	31			A2 J8P31
6			J6P6	31			A2 J6P31
7			J16P3	A2J7P 32			A2 J15P3
8			J8P1				
8			J4P30				
9			J13P23				
10			J6 P10				
11			J20P5				
12			J20P7				
13			J16P9				
14			J14P32				
15			J8P15				
15			J6P15				
16			J14P28				
17			J19P2				
18			J19P1				
19			J6P16				
20			A2 J4P22				
21			N/C				
22			A2 J20P20				
A2J7P 22			A2 J6P32				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J8P 1			A2J9P1
1			J7P8
2			J9P2
2			J5P2
3			J9P3
3			A2J7P24
4			N/C
5			N/C
6			A2J9P6
6			A2J7P6
7			A2J7P27
8			N/C
9			A2J7P3
10			N/C
11			N/C
12			N/C
13			N/C
14			N/C
15			A2J9P15
15			A2J7P15
16			N/C
17			N/C
18			N/C
19			N/C
20			N/C
21			N/C
22			N/C
23			N/C
A2J8P 24			N/C
A2J8P25			N/C
26			N/C
27			N/C
28			N/C
29			N/C
30			N/C
31			A2J9P31
31			A2J7P31
A2J8P 32			N/C

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J9P 1			A2 J8P1	A2J9P 27			N/C
2			J10P2	28			N/C
2			J8P2	29			N/C
3			A2 J8P3	30			N/C
4			N/C	31			A2J10P31
5			N/C	31			A2J8P31
6			A2 J10P6	A2J9P 32			A2J1P7
6			A2J8P6				
7			A2 J7P28				
8			N/C				
9			A2 J7P1				
10			N/C				
11			N/C				
12			N/C				
13			N/C				
14			N/C				
15			A2J10P15				
15			A2J8P15				
16			N/C				
17			N/C				
18			N/C				
19			N/C				
20			N/C				
21			N/C				
22			N/C				
23			N/C				
24			N/C				
25			N/C				
A2J9P 26			N/C				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J10P 1			A2 J11P20
2			A2 J11P2
2			A2 J9P2
3			A4J1PG4
4			A2 J15P30
4			A2J6P20
5			N/C
6			A2 J13P6
6			J9P6
7			J13P1
7			J6P14
8			J12P13
9			A2 J6P24
9			A1M1 +
10			A2 J11P3
11			A2 J13P3
11			A2 J6P18
12			N/C
13			N/C
14			N/C
15			A2 J12P15
15			J9P15
16			J11P8
17			J11P1
18			J13P4
18			J6P21
19			J11P11
20			J13P13
A2J10P 21			A2 J13P5

FROM	TERM TYPE	ASSY CODE	TO
A2J10P 21			A2 J6P23
22			N/C
23			A4J1PH3
24			A1M1 -
25			A2 J11P23
25			J6P25
26			J13P8
26			J6P26
27			J13P10
27			J6P27
28			J13P11
28			J6P29
29			J13P11
29			J6P22
30			J18P22
31			J12P31
31			J9P31
A2J10P 32			A2 J18P23

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A2J11P 1			A2 J10P17	A2J11P 24			A2 J6P5
2			J13P2	25			J13P25
2			J10P2	25			J10P25
3			A2 J10P10	26			J15P23
4			N/C	26			A2 J6P7
5			N/C	27			N/C
6			N/C	28			N/C
7			N/C	29			N/C
8			A2J20P19	30			N/C
8			A2J10P16	31			N/C
9			N/C	A2J11P 32			A2J13P22
10			N/C				
11			A2J20P17				
11			A2J10P19				
12			N/C				
13			N/C				
14			A2J15P10				
14			A2J6P3				
15			N/C				
16			N/C				
17			A2J15P16				
17			A2J6P1				
18			N/C				
19			N/C				
20			A2J10P1				
21			N/C				
22			A2J6P4				
23			N/C				
A2J11P 24			A2J15P21				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J12P 1			N/C
2			N/C
3			A2J18P7
4			A2J18P10
5			A2J18P12
6			N/C
7			N/C
8			N/C
9			A2J13P18
10			N/C
11			N/C
12			N/C
13			A2J14P8
13			A2J10P8
14			N/C
15			A2J13P15
15			A2J10P15
16			N/C
17			N/C
18			N/C
19			N/C
20			N/C
21			N/C
22			N/C
23			N/C
24			A2J15P29
25			N/C
26			A2J14P7
A2J12P27			N/C

FROM	TERM TYPE	ASSY CODE	TO
A2J12P 28			N/C
29			A2J18P5
30			N/C
31			A2J13P31
31			A2J10P31
A2J12P32			A2J18P13

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J13P 1			A2 J17P10
1			J10P7
2			J15P2
2			J11P2
3			J17P9
3			J10P11
4			J17P8
4			J10P18
5			J17P7
5			J10P21
6			J15P6
6			A2 J10P6
7			N/C
8			A2 J18P17
8			A2 J10P26
9			N/C
10			A2J18P18
10			J10P27
11			J18P19
11			A2J10P28
12			N/C
13			A2J10P20
14			N/C
15			A2J14P15
15			A2J12P15
16			N/C
17			A2J18P20
17			A2J10P29
A2J13P 18			A2J12P9

FROM	TERM TYPE	ASSY CODE	TO
A2J13P 19			N/C
20			A2J17P14
21			N/C
22			A2J11P32
23			J14P10
23			J17P9
24			J17P13
25			J15P25
25			A2J11P25
26			N/C
27			N/C
28			N/C
29			A2J17P12
30			N/C
31			A2J14P31
31			A2J12P31
A2J13P 32			A2J17P11

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J14P 1			N/C
2			N/C
3			A2 J6P17
4			N/C
5			A2J6P19
6			N/C
7			A2J15P27
7			J12P26
8			J12P13
9			J19P4
10			J19P28
10			A2 J13P23
11			N/C
12			N/C
13			N/C
14			N/C
15			A2J15P15
15			A2J13P15
16			N/C
17			N/C
18			N/C
19			N/C
20			N/C
21			N/C
22			N/C
23			N/C
24			N/C
25			N/C
A2J14P 26			A2J15P26

FROM	TERM TYPE	ASSY CODE	TO
A2J14P 27			A2J16P4
27			J1P4
28			J1P16
28			J16P12
30			J19P27
30			J6P16
31			J15P31
31			J13P31
32			J19P29
A2J14P 32			A2J1P14

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J15P 1			A4 J1P62
1			A1 DS1P1
2			A2 J16P2
2			A2 J13P2
3			A2 J7P32
4			N/C
5			N/C
6			A2 J16P6
6			A2 J13P6
7			N/C
8			N/C
9			N/C
10			A2J18P4
10			A2J11P14
11			N/C
12			N/C
13			N/C
14			N/C
15			A2J16P15
15			A2J14P15
16			A2J18P8
16			A2 J11P17
17			N/C
18			N/C
19			A2J18P11
19			A2J11P22
20			N/C
A2J15P 21			A2J18P14

FROM	TERM TYPE	ASSY CODE	TO
A2J15P 21			A2 J11P24
22			N/C
23			A2J18P9
23			A2J11P26
24			N/C
25			A2J17P25
25			J13P24
26			J14P26
27			J12P24
28			J19P30
27			J14P7
30			J10P4
31			J16P31
31			J14P31
A2J15P 32			A2 J7P29
A2J15P 15			A4 J8 P2
A2J15P 15			A4 J9 P2

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J16P 1			A4 J4P1
2			A2 J21P2
2			J15P2
3			J7P7
4			A2 J14P27
5			A4 J7P1
6			A2 J17P6
6			A2 J15P6
7			A4 J9P1
8			A4 J8P1
9			A2 J7P13
10			A1 TP3
10			A4 J3P1
11			A1 TP2
11			A4 J6P1
12			A2 J14P28
13			A1S1A6PC
14			A2J17P5
15			A2J11P15
15			A2J15P15
16			A1S1A4PC
17			A2J17P4
18			A1S1A5PC
19			A2J17P3
20			A1S1B1PC
21			A2J17P1
22			A1S1B4PC
23			A2J18P28
A2J16P 24			A1S1B2PC
A2J16P 25			N/C
26			N/C
27			A2J18P29
28			H1S1B3PC
29			A2J18P27
30			A1S1B5PC
31			A2J11P31
31			A2J15P31
A2J16P 32			A2J18P26
15			A4J3P2
15			A4J6P2
15			A4J7P2
A2J16P 15			A4J8P2

Table 5-2 (Cont'd). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J17P 1			A2J16P21
1			A2J19P19
2			A2J18P30
3			A2J16P19
3			A2J19P11
4			A2J16P17
4			A2J19P14
5			A2J16P14
5			A2J19P12
6			J18P6
6			J16P6
7			A2J13P5
7			A1A1P18
8			A1A1P17
8			A2J13P4
9			A1A1P16
9			A2J13P3
10			A1A1P15
10			A2J13P1
11			A1A1P8
11			A2J13P32
12			A1A1P7
12			A2J13P29
13			A1A1P6
13			A2J13P24
14			A1A1P5
14			A2J13P20
15			A2J18P15
A2J17P 15			A2J16P15

FROM	TERM TYPE	ASSY CODE	TO
A2J17P 15			A1S4P1
16			A4J1PE4
17			C12
18			E6
19			A4J1P E2
20			A2J18P24
21			A2J20P27
22			A2J18P32
23			A1S1A2P6
24			A1S1A3P6
25			A2J18P25
25			A2J15P25
26			A4J1PE8
27			A1S1B6P6
28			A4J1PE10
29			A2J19P16
30			A1S1B6P2
31			A2J18P31
31			A2J16P31
A2J17P 32			A1S1A1P6

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J18P 1			A1 A1P1
2			A1 A1P3
3			A1 A1P2
4			A2J15P10
5			J12P29
6			J17P6
6			J19P6
7			J12P3
8			J15P16
9			J15P23
10			J12P4
11			J15P19
12			J12P5
13			J12P32
14			J15P21
15			J19P15
15			A2J17P15
15			A1 S15P1
16			A1 A1P4
17			A2J13P17
20			A1 A1P14
18			A2J13P11
19			A1 A1P13
19			A2J13P10
18			A1 A1P12
20			A2J13P8
17			A1 A1P11
21			A1 A1P20
A2J18P 22			A2J10P30

FROM	TERM TYPE	ASSY CODE	TO
A2J18P 22			A1 A1P19
23			A2J10P32
23			A1 A1P21
24			A2J20P16
24			J17P20
25			J19P25
25			J17P25
26			J19P18
27			J19P17
28			J19P13
29			J19P10
30			J17P2
31			J19P31
31			J17P31
32			A2J17P22
26			A2J16P32
27			A2J16P29
28			A2J16P23
A2J18P 29			A2J16P27

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J19P 1			A2 J7P18
2			J7P17
3			J7P26
4			A2J14P9
5			A1 A1 P49
6			A2 J18P6
6			A2 J20P2
7			A1 A1P53
8			A1 A1P52
9			A1 A1P50
10			A2 J20P13
10			A2 J18P29
11			A2J20P30
11			J17P3
12			J20P29
12			J17P5
13			J20P3
13			A2 J18P28
14			A2 J20P28
14			J17P4
15			J20P15
15			J18 P15
16			J17P29
17			J20P4
17			A2 J18P27
A2J19P 18			A2 J20P1

FROM	TERM TYPE	ASSY CODE	TO
A2J19P 18			A2 J18P26
19			A2 J17P1
19			A2 J20P32
20			A1 A1P51
21			48
22			54
23			A1 A1P47
24			A2 J6P8
25			J18P25
25			J20P25
26			J6P9
27			J14P30
28			J14P10
29			J14P32
29			J20P10
30			J15P28
31			J20P31
31			A2 J18P31
32			A1 S15 P2
A2J19P 15			A1 S2P3

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J20P 1			A2 J19P18
2			J19P6
2			J21P6
3			J19P13
4			J19P17
5			J7P11
6			J7P5
7			A2J7P12
8			A1 A1P31
9			A1 A1P29
10			A2J19P29
11			A2J4P32
11			A1 A1P32
12			A2J6P30
13			A2J19P10
14			A2J5P1
14			A1 A1P34
15			A2J19P15
15			A2J21P15
15			A1S3P6
16			A2J18P24
17			A2J11P11
17			A1 A1P25
18			A1 A1P30
19			A2J11P8
19			A1 A1P26
20			A2J7P22
21			A1 A1P24
A2J20P22			A1 A1P35
A2J20P23			A1 A1P36
24			A1 A1P33
25			A2J19P25
25			A1 A1P74
25			A3Q4E
25			A1S3PA
26			A1 A1P23
27			A2J17P21
28			J19P14
29			J19P12
30			J19P11
31			J19P31
31			J21P31
A2J20P32			A2J19P17

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A2J21P 1			A3 C1 +
2			A2J16P2
3			A3 Q1B
4			A3 CR5C
4			A2 J21P15
5			A3 C2 −
6			A3 Q2E
6			A2J20P2
7			A3 Q1E
8			N/C
9			N/C
10			N/C
11			N/C
12			N/C
13			N/C
14			A3 C4 +
15			A2 J21P4
15			A2 J20P15
15			A2J21P30
16			N/C
17			N/C
18			N/C
19			N/C
20			N/C
21			A3 Q4 B
22			N/C
23			N/C
24			A3 Q2 B
A2J21P 25			N/C

FROM	TERM TYPE	ASSY CODE	TO
A2J21P 26			A3C2 +
27			C3 +
28			Q3B
29			C3 +
30			A3C4 −
30			A2J21P32
30			A2J21P15
31			A3 C1 −
31			A2J20P31
32			A3 Q3E
A2J21P 32			A2J21P30

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A3Q1B			A2J21P3
Q1E			7
Q2B			24
Q2E			6
Q3B			28
Q3E			32
Q4B			A2J21P21
A3Q4E			A2J20P25
A3C1+			A2J21P1
C1-			31
C2+			26
C2-			5
C3+			27
C3-			29
C4+			14
A3C4-			A2J21P30
A3CR5C			A2J21P4
A3T1P1			A4J10P2
A3T1P3			N/C
A3T1P2			A4F1P2
A3T1P3			A4F1P2

FROM	TERM TYPE	ASSY CODE	TO
A4J1PA2			A1S1A4P2
A4			A1S1A5P2
A6			A1S1A6P2
A8			A1S1B1P2
A10			A1S1B2P2
A6			A1S1B3P2
B1			A4J11P1
B3			
B5			
B7			
B9			
B11			
B13			A4J11P1
A2			A1S1B5P2
C4			A1S1A3P2
C6			A1S1A2P2
C8			A1S1A1P2
C10			A2J1P13
C12			A2J17P17
D1			A4J11P1
D3			
D5			
D7			A4J11P1
D9			A2J1P14
D11			A4J11P1
A4J1PA4			A1S1B4P2
D13			A1S1A5P2
C2			A1S1A4P2
A4J1PA12			A1S1A6P2

Table 5-2 (Cont'd). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO	FROM	TERM TYPE	ASSY CODE	TO
A4J1PE2			A2J17P19	A4J2P1			A2J1P1
E4			A2J17P16	A4J2P2			SHIELD
E6			A2J17P18	A4J2P2			A4J4P2
E8			A2J17P26	A4J2P2			A4J11P1
E10			A2J17P28				
E12			A1S1C1PC	A4J3P1			A2J16P10
F1			A4J11P1	A4J3P2			A2J16P15
F3							
F5							
F7				A4J4P1			A2J16P1
F9				A4J4P2			A4J2P2
F11				A4J4P2			A4J5P2
F13			A4J11P1	A4J4P2			
G2			A2J15P1	A4J5P1			A2J6P29
G4			A4J10P3	A4J5P2			A4J4P2
G6			A2J1P11	A4J5P2			A4J11P1
G8			N/C	A4J5P2			
G10				A4J6P1			A2J16P11
G12				A4J6P2			A2J16P15
H1			N/C				
H3			A2J10P23				
H5			A2J1P9	A4J7P1			A2J16P5
H7			N/C	A4J7P2			A2J16P15
H9							
H11			N/C				
A4J1P H13			A1S3P7	A4J8P1			A2J16P8
A10			A1S1B1P2	A4J8P2			A2J15P15
A8			A1S1B2P2				

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A4J9P1			A2J16P7
A4J9P2			A2J15P15
A4J10P1			A1S3P3
2			A3T1P1
2			A4B1P1
A4J10P3			A4J12P1
A4J10P2			A4B1RED
A4F1P2			A4E8
A4F1P1			A1S3P4
A4F1P2			A4B1P2
A4F1P2			A3T1P2
A4F1P2			A3T1P3
A4J11P1			A4J2P2
A4J11P1			A4J1P B1
			B3
			B5
			B7
			B9
			B11
			B13
			D1
			D3
			D5
			D7
			D11
A4J11P1			A4J1PF1

FROM	TERM TYPE	ASSY CODE	TO
A4J11P1			A4J1P F3
			F5
			F7
			F9
			F11
			A4J1PF13
A4J11P1			A2J1P15
A4J11P1			A4J5P2
A4J12P1			CHASGRD
A4J12P1			A4J10P3
A4B1P1			A4J10P2
A4B1P2			A4F1P2
A4B1YEL			A4E8
A4B1BLUE			A4E9
A4B1RED			A4J10P2
CHASGRD			A4J12P1
A4E8			A4F1P2
A4E8			A4B1YEL
A4E8			A4C1P1
A4E9			A4C1P2
A4E9			A4B1BLUE
A4C1P1			A4E8
A4C1P2			A4E9

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A1A1P 1			A2J 18P1
2			18P3
3			18P2
4			18P16
5			17P14
6			17P13
7			17P12
8			A2J 17P11
9			N/C
10			N/C
11			A2J 18P17
12			18P18
13			18P19
14			18P20
15			17P10
16			17P9
17			17P8
18			17P7
19			18P22
20			18P21
21			18P23
23			20P26
24			20P21
25			20P17
26			A2J 20P19
27			N/C
28			N/C
29			A2J 20P9
A1A1P 30			A2J 20P18

FROM	TERM TYPE	ASSY CODE	TO
A1A1P 31			A2J 20P8
32			20P11
33			20P24
34			20P14
35			20P22
36			20P23
47			19P23
48			19P21
49			19P5
50			19P6
51			19P20
52			19P8
53			19P7
54			A2J 19P22
73			A1S2P4
74			A2J 20P25
75			A1S2P2
A1A1P 76			A1S2P1

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A1S1A1PC			A2J17P32
A1S1A1P1			A1S15PC
A1S1A1P2			A4J1PC8
A1S1A2PC			A2J17P23
A1S1A2P1			A1S14PC
A1S1A2P2			A4J1PC6
A1S1A3PC			A2J17P24
A1S1A3P1			A1S13PC
A1S1A3P2			A4J1PC4
A1S1A4PC			A2J16P16
A1S1A4P1			A1S12PC
A1S1A4P2			A4J1PC2
A1S1A5PC			A2J16P18
A1S1A5P1			A1S11PC
A1S1A5P2			A4J1PD13
A1S1A6PC			A2J16P13
A1S1A6P1			A1S10PC
A1S1A6P2			A4J1PA12
A1S1B1PC			A2J16P20
A1S1B1P1			A1S9PC
A1S1B1P2			A4J1PA10

FROM	TERM TYPE	ASSY CODE	TO
A1S1B2PC			A2J16P24
A1S1B2P1			A1S8PC
A1S1B2P2			A4J1PA8
A1S1B3PC			A2J16P28
A1S1B3P1			A1S7PC
A1S1B3P2			A4J1PA6
A1S1B4PC			A2J16P22
A1S1B4P1			A1S6PC
A1S1B4P2			A4J1PA4
A1S1B5PC			A2J16P30
A1S1B5P1			A1S5PC
A1S1B5P2			A4J1PA2
A1S1B6PC			A2J17P27
A1S1B6P1			A1S4P3
A1S1B6P2			A2J17P30
A1S1C1PC			A4J1PE12
A1S1C1P1			A1S4P1
A1S1C1P2			A1S3P8
A1S1C1P2			A1S4P2
A1S2P1			A1A1P76
A1S2P2			A1A1P75
A1S2P3			A1S2P4
A1S2P4			A1S2P3

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A1S2P4			A1A1P73
A1S2P4			A1DS2P2
A1S3P 1			NIC
2			NIC
3			A4J10P1
4			A4F1P1
5			A1S3P7
6			A2J20P15
6			A1S3PB
7			A1S3P5
7			A4J1PH13
8			A1S1C1P2
A			A2J20P25
A1S3P B			A1S3P6
A1S4P 1			A1S1C1P1
1			A2J17P15
2			A1S1C1P2
2			A1S5P2
3			A1S1B6P1
3			A1S4P4
A1S4P4			A1S4P3
A1S5PC			A1S1B5P1
1			A1S6P1
2			A1S4P2
A1S5P2			A1S6P2

FROM	TERM TYPE	ASSY CODE	TO
A1S6PC			A1S1B4P1
A1S6P1			A1S5P1
A1S6P1			A1S7P1
A1S6P2			A1S5P2
A1S6P2			A1S7P2
A1S7PC			A1S1B3P1
A1S7P1			A1S6P1
A1S7P1			A1S8P1
A1S7P2			A1S6P2
A1S7P2			A1S8P2
A1S8PC			A1S1B2P1
A1S8P1			A1S7P1
A1S8P1			A1S9P1
A1S8P2			A1S7P2
A1S8P2			A1S9P2
A1S9PC			A1S1B1P1
A1S9P1			A1S8P1
A1S9P1			A1S10P1
A1S9P2			A1S6P2
A1S9P2			A1S10P2
A1S10PC			A1S1H6P1
A1S10P1			A1S9P1
A1S10P1			A1S11P1
A1S10P2			A1S9P2
A1S10P2			A1S11P2

Table 5-2 (Cont'd.). Wiring Schedule (11157)

FROM	TERM TYPE	ASSY CODE	TO
A1S11PC			A1S1A5P1
A1S11P1			A1S10P1
A1S11P1			A1S12P1
A1S11P2			A1S10P2
A1S11P2			A1S12P2
A1S12PC			A1S1A4P1
A1S12P1			A1S11P1
A1312P1			A1S13P1
A1S12P2			A1S11P2
A1S12P2			A1S13P2
A1S13PC			A1S1A3P1
A1S13P1			A1S12P1
A1S13P1			A1S14P1
A1S13P2			A1S12P2
A1S13P2			A1S14P2
A1S14PC			A1S1A2P1
A1S14P1			A1S13P1
A1S14P1			A1S15P1
A1S14P2			A1S13P2
A1S14P2			A1S15P2
A1S15PC			A1S1A1P1
A1S15P1			A1S14P1
A1S15P1			A2J18P15
A1S15P2			A1S14P2
A1S15P2			A2J19P32

FROM	TERM TYPE	ASSY CODE	TO
A1DS1P1			A2J15P1
A1DS1P2			A2J3P25
A1DS2P1			A2J1P14
A1DS2P2			A1DS3P2
A1DS2P2			A1S2P4
A1DS3P1			A2J1P13
A1DS3P2			A1DS2P2
A1M1−			A2J10P24
A1M1+			A2J10P9
A1M2+			A2J1P10
A1M2−			A2J1P20
A1TP1			A2J1P15
A1TP2			A2J16P11
A1TP3			A2J16P10
A1TP4	⊸	⊸	A2J1P1
A1TP1	⌐		SHIELD
A2J19P15			A1S2P3

SECTION 6

REPLACEABLE PARTS LIST AND RECOMMENDED SPARES

6.1 GENERAL

This section contains a tabular listing, (Table 6-1) by major assembly, of electrical and mechanical parts in the Model 2721 PCM Signal Conditioner. A detailed component listing of each printed wiring assembly (card) in the unit is included at the end of Table 6-1.

Each major assembly in the DESCRIPTION column of Table 6-1 is identified by an A (assembly) designation in the REF. DESIG. column. (The physical location of each major assembly is shown in Figure 1-2). Other columns in Table 6-1 include EMR Stock Number, Manufacturer's Code (identified in Table 6-3), Manufacturer's Part Number, Total Quantity (TQ) used in the unit and Recommended Spares (RS). The electrical parts listed in Table 6-2 represent the total quantity and total number of recommended spares of multi-used parts in the Model 2721. The recommended spares as listed in Table 6-1 and 6-2 are based on the following listed conditions: (Paragraph 6.2 describes various other considerations for use as an aid in determining individual provisioning requirements.)

1. Operating time -- 8 hours/day, 5 days/week (2080 hours/year).
2. Operating temperature -- 0°C to 30°C.
3. User has capability to repair to the component level.
4. Failure rates are constant.
5. A 0.9 probability of being able to repair from the recommended complement for one year.
6. Equipment will be used as ground equipment (as opposed to vehicular or airborne).

6.2 PROVISIONING CONSIDERATIONS

The selection of an optimum spare parts complement involves a number of considerations known only to the user. The considerations include operating time and cycles, operating environment, number of equipments to be spared and their locations with respect to one another, urgency of returning an equipment to service, troubleshooting, repair and test capability, stock of commonly used parts, etc.

Sparing considerations known to EMR include mean-time-between-failures for parts and assemblies under various operating environments, prices, relative ease of troubleshooting, repair, retest, etc.

Table 6-4 lists the type of information required in order for EMR to recommend an optimum spare parts complement for specific operating and logistic situations.

If the information outlined in Table 6-4 is supplied to EMR, a recommended list will be furnished at no cost for each individual situation.

6.3 ORDERING INSTRUCTIONS

When ordering parts, complete description of each part as listed in DESCRIPTION column of parts list must accompany order. Also included, must be the EMR stock number and manufacturers name and part number.

Table 6-1. Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	SIGNAL CONDITIONER ASSY	233-89-00005	06141	11387	1		Price and delivery of recommended spares on request.
	CARD FILE ASSY	112-89-00003	06141	7542	1		
A2	CARD FILE CHASSIS	042-99-00021	06141	7556	1		
A1	SUBPANEL ASSY	191- 89-00012	06141	11385	1		
A1M2	METER, DC Microamp	170-99-00001	11201	802-8	1		
A1M3	METER, DC Microamp	170-99-00002	11201	802-7			
DS1	LIGHT, Display Red	155-98-00016	03797	CFW-22556-01	1		
DS2, DS3	LIGHT, Display White	155-98-00017	03797	CFW-22556-05	2		
S1	SWITCH, Rotary	250-98-00026	71450	212-18731-3	1		
S2, S4	SWITCH, Button, Miniature	250-98-00021	07137	MBS-C-BT4	2		
S3	SWITCH, Pushbutton, Lighted	250-98-00044	97564	1160A7L56 WIL	1		
	LAMP, T-1 3/4, 28V, 0.04A	151-02-00001	G81349	MS25237-327	1		
S5 thru S15	SWITCH, Toggle	250-98-00025	09353	7101	11		
TP1 thru TP4	JACK, Test	143-98-00008	74970	105-231-1	4		
A1A1	PRINTED WIRING ASSY, Display Card	205-89-00138	06141	11417	1		
CR3 thru CR35	DIODE	088-99-00159	06141	636	32		
DS1 thru DS39	LAMP, Unbased, 28V, 40 Ma	151-98-00008	71744	CM1764	39		
Q1 thru Q23	TRANSISTOR	263-10-39030	JEDEC	2N3903	23		
R1	RESISTOR, 470 Ohm, 10%, 2W	624-03-47009			1		
R2 thru R47	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222 J	47		
	FRONT PANEL ASSY	191-89-00011	06141	11386	1		
	LENS, Amber	154-98-00001	03797	110-10988-204	39		

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
A3	POWER SUPPLY ASSY	202-89-00003	06141	6527	1		
C1	CAPACITOR, 5500 Mf, -10%, +75%, 25V	353-75-55006	56289	36D552G025 AB2C	1		
C2, C3, C4	CAPACITOR, 2600 Mf, -10%, +75%, 25V	353-78-26006	56289	36D262G050 AB2C	3		
CR1,CR2 CR3,CR4	RECTIFIER	214-98-00001	04713	MDA-952-2	4		
R1	RESISTOR, 1K, 5%, 1W	623-02-10000	01121	RC326F102 J	1		
R2, R3, R4	RESISTOR, 3.3K, 5%, 1W	623-02-33000	01121	RC326F332 J	3		
T1	TRANSFORMER	262-99-00017	06141	938	1		
A4	REAR PANEL ASSY	191- 89-00133	06141	6529-1	1		
	FUSE HOLDER	134-98-00006	75915	342004	1		
A4F1	FUSE, Slo-Blo, 5Amp, 125V	120-98-00024	75915	313005	1		
J1	CONNECTOR (a plug) 52-pin	063-98-00056	13511	220-1N052	1		
J2 thru J9	CONNECTOR, BNC	063-02-00014	91737	UG-1094A/U	8		
J10	CONNECTOR, Male, Motor Base	063-98-00021	74545	7486	1		
	PRINTED WIRING ASSY, Input Amplifier	205-89-00059	06141	6485	1		
	PRINTED WIRING ASSY, SØ to NRZ Converter	205-89-00051	06141	6483	1		
	PRINTED WIRING ASSY, Bit Rate Filter	205-89-00080	06141	6487	1		
	PRINTED WIRING ASSY, Reset Integrator	205-89-00086	06141	6491	1		
	PRINTED WIRING ASSY, Bit Rate/2 Filter	205-89-00061	06141	6489	1		
	PRINTED WIRING ASSY, Phase Shifter	205-89-00062	06141	6493	1		
	PRINTED WIRING ASSY, Bit-Decision and Code Converter	205-89-00063	06141	6495	1		
	PRINTED WIRING ASSY, Negative Counter	205-89-00064	06141	6497	1		
	PRINTED WIRING ASSY, Positive Counter	205-89-00065	06141	6499	1		
	PRINTED WIRING ASSY, Loop Resistor	205-89-00250	06141	13160	1		
	PRINTED WIRING ASSY, Loop Capacitor	205-89-00067	06141	6503	1		

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	PRINTED WIRING ASSY, Divider	205-89-00068	06141	6505	1		Price and delivery of recommended spares on request.
	PRINTED WIRING ASSY, VCO	205-89-00252	06141	13215	1		
	PRINTED WIRING ASSY, Split-Phase Clock Reset	205-89-00361	06141	14925	1		
	PRINTED WIRING ASSY, Loss Lock and Counter	205-89-00071	06141	6511	1		
	PRINTED WIRING ASSY, Output Amplifier	205-89-00106	06141	11413	1		
	PRINTED WIRING ASSY, Control No. 1	205-89-00078	06141	11384	1		
	PRINTED WIRING ASSY, Control No. 2	205-89-00079	06141	11382	1		
	PRINTED WIRING ASSY, Control No. 3	205-89-00080	06141	11380	1		
	PRINTED WIRING ASSY, Control No. 4	205-89-00081	06141	11378	1		
	PRINTED WIRING ASSY, Regulator	205-89-00251	06141	13163	1		

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	PRINTED WIRING ASSY, Input Amplifier	205-89-00059	06141	6485	1	-	Price and delivery of recommended spares on request.
	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	2	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2	CAPACITOR, 0.1 MF, 10%, 200V	330-14-10002	06141	634	1	-	
C3	CAPACITOR, 10 MF, 10%, 100V	358-02-10004	73705	W1-106E	1	-	
C4	CAPACITOR, 1 MF, 10%, 100V	358-02-10003	73705	W1-105E	1	-	
C5	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C6	CAPACITOR, 100 MF, 20%, 20V	339-22-10005	06141	601	1	-	
C7	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C8	CAPACITOR, 100 MF, 20%, 20V	339-22-10005	06141	601	1	-	
C9	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C12	CAPACITOR, 4700 PF, 1%, 500V	305-20-47000	06141	600	1	-	
C13	CAPACITOR, 4700 PF, 1%, 500V	305-20-47000	06141	600	1	-	
CR1	DIODE	088-99-00159	06141	636	1	-	
CR2	DIODE	088-99-00159	06141	636	1	-	
DL1	DELAY LINE	081-98-00001	00222	DP2	1	-	
K1	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	1	-	
K2	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	1	-	
K3	RELAY, 2 Form A Contacts	219-98-00012	95073	24MM-2A	1	-	
K4	RELAY, 2 Form A Contacts	219-98-00012	95073	24MM-2A	1	-	
K5	RELAY, 1 Form B Contact	219-98-00014	95073	24MM1B	1	-	
K6	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
Q1	TRANSISTOR, MM2484	263-16-00059	04713	MM2484	1	-	
Q2	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q3	TRANSISTOR	263-10-37980	JEDEC	2N3798	1	-	
Q4	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q5	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	
Q6	TRANSISTOR, MM2484	263-16-00059	04713	MM2484	1	-	
Q7	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q8	TRANSISTOR	263-10-37980	JEDEC	2N3798	1	-	
Q9	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Q11	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	Price and delivery of recommended spares on request.
Q12	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	
Q13	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	
R1	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R2	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R3	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R4	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R5	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R6	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R9	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R10	RESISTOR, 1 Meg, 5%, 1/4W	616-02-10003	01121	RC07GF105J	1	-	
R11	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R12	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R13	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R14	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R15	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R16	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R17	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R19	RESISTOR, 27K, 5%, 1/4W	616-02-27001	01121	RC07GF273J	1	-	
R20	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R21	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R22	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R23	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R24	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R27	RESISTOR, 1.5K, 5%, 1/4W	616-02-15000	01121	RC07GF152J	1	-	
R28	RESISTOR, 4.64K, 1%, 1/8W	605-09-46400	06141	625	1	-	
R29	RESISTOR, 4.64K, 1%, 1/8W	605-09-46400	06141	625	1	-	
R30	RESISTOR, 16.2K, 1%, 1/8W	605-09-16201	06141	625	1	-	
R31	RESISTOR, 120 Ohm, 5%, 1/4W	616-02-12009	01121	RC07GF121J	1	-	
R32	RESISTOR, 120 Ohm, 5%, 1/4W	616-02-12009	01121	RC07GF121J	1	-	
R33	RESISTOR, 4.64K, 1%, 1/8W	605-09-46400	06141	625	1	-	
R34	RESISTOR, 4.64K, 1%, 1/8W	605-09-46400	06141	625	1	-	

Table 6-1 (Cont'd.). Model2 721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R35	RESISTOR, 51.1K, 1%, 1/8W	605-09-51101	06141	625	1	-	Price and delivery of recommended spares on request.
R36	RESISTOR, 1.8K, 5%, 1/4W	616-02-18000	01121	RC07GF182J	1	-	
R37	RESISTOR, 20.5K, 1%, 1/8W	605-09-20501	06141	625	1	-	
R38	RESISTOR, 40.2K, 1%, 1/8W	605-09-40201	06141	625	1	-	
R39	RESISTOR, 20.5K, 1%, 1/8W	605-09-20501	06141	625	1	-	
R40	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R41	POTENTIOMETER, 200 Ohm, 20%, 1/3W	201-98-00047	01121	NX201M	1	-	
Z1	INTEGRATED CIRCUIT, MC360G	046-16-00003	04713	MC 360G	1	-	
Z2	INTEGRATED CIRCUIT, MC354G	046-16-00005	04713	MC 354G	1	-	
Z3	INTEGRATED CIRCUIT, MC360G	046-16-00003	04713	MC 360G	1	-	
Z4	INTEGRATED CIRCUIT, MC352G	046-16-00004	04713	MC 352G	1	-	
	PRINTED WIRING ASSY, SØ to NRZ Converter	205-89-00051	06141	6483	1	-	
TP1-5	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	5	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C3	CAPACITOR, 100 MF, 20%, 20V	339-22-10005	06141	601	1	-	
C4	CAPACITOR, 100 MF, 20%, 20V	339-22-10005	06141	601	1	-	
C5	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C6	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C7	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C8-C10	CAPACITOR, 51 PF, 1%, 500V	304-13-05109	06141	600	3	-	
C11	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C12	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
CR1-CR14	DIODE	088-99-00179	06141	638	14	2	
CR15	DIODE	088-99-00259	06141	642-12	1	-	
CR16	DIODE	088-99-00259	06141	642-12	1	-	
K1	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
Q1	TRANSISTOR, MM2484	263-16-00059	04713	MM2484	1	-	
Q2	TRANSISTOR	263-10-37980	JEDEC	2N3798	1	-	
Q3	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q4	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Q5	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	Price and delivery of recommended spares on request.
Q6	TRANSISTOR	263-10-35660	JEDEC	2N3566	1	-	
Q7	TRANSISTOR, MM2484	263-16-00059	04713	MM2484	1	-	
Q8	TRANSISTOR	263-10-37980	JEDEC	2N3798	1	-	
Q9	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q10	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q11	TRANSISTOR	263-16-00059	04713	MM2484	1	-	
Q12	TRANSISTOR	263-10-37980	JEDEC	2N3798	1	-	
Q13	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q14	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q15	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q16	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q17	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q18	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q19	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q20	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q21	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q22	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
R1	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R2	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R3	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R4	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R5	RESISTOR, 27K, 5%, 1/4W	616-02-27001	01121	RC07GF273J	1	-	
R6	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R7	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R8	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R9	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R10	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R11	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R12	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R13	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R14	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R15	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	Price and delivery of recommended spares on request.
R16	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R17	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R18	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R19	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R20	RESISTOR, 1.5K, 10%, 1/2W	622-03-15000	01121	RC20GF152K	1	-	
R21	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R22	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R23	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R24	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R25	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R26	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R27	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R28	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R29	RESISTOR, 1K, 10%, 1/2W	622-03-10000	01121	RC20GF102K	1	1	
R30	RESISTOR, 1K, 10%, 1/2W	622-03-10000	01121	RC20GF102K	1	-	
R31	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R32	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R33	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	1	-	
R34	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	1	-	
R35	RESISTOR, 270 Ohm, 10%, 1W	623-03-27009	01121	RC32GF271K	1	-	
R36-R39	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	4	-	
R40	RESISTOR, 390 Ohm, 10%, 1W	623-03-39009	01121	RC32GF391K	1	-	
R41-R43	POTENTIOMETER, 200 Ohm, 20%, 1/3W	201-98-00047	01121	NX201M	3	-	
R44	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R45	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R46	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R47	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
Z1	INTEGRATED CIRCUIT, MC356G	046-16-00001	04712	MC 356G	1	-	
	PRINTED WIRING ASSY, Bit Rate Filter	205-89-00060	06141	6487	1	-	
TP1	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	1	-	
C1	CAPACITOR, 1.5 MF, 5%, 35V	337-05-15003	06141	601	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
C2	CAPACITOR, .15 MF, 5%, 35V	336-05-15002	06141	601	1	-	Price and delivery of recommended spares on request.
C3	CAPACITOR, .015 MF, 5%, 35V	336-05-15001	06141	601	1	-	
C4	CAPACITOR, 1500 PF, 1%, 500V	305-20-15000	06141	600	1	-	
C5	CAPACITOR, 100 PF, 1%, 500V	304-20-10009	06141	600	1	-	
C6	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C7	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C8	CAPACITOR, 1.8 MF, 5%, 35V	337-05-18003	06141	601	1	-	
C9	CAPACITOR, .18 MF, 5%, 35V	336-05-18002	06141	601	1	-	
C10	CAPACITOR, .018 MF, 5%, 35V	336-05-18001	06141	601	1	-	
C11	CAPACITOR, 1800 PF, 1%, 500V	305-20-18000	06141	600	1	-	
C12	CAPACITOR, 180 PF, 1%, 500V	304-20-18009	06141	600	1	-	
C13	CAPACITOR, 1.2 MF, 5%, 35V	337-05-12003	06141	601	1	-	
C14	CAPACITOR, .12 MF, 5%, 35V	336-05-12002	06141	601	1	-	
C15	CAPACITOR, .012 MF, 5%, 35V	336-05-12001	06141	601	1	-	
C16	CAPACITOR, 1200 PF, 1%, 500V	305-20-12000	06141	600	1	-	
C17	CAPACITOR, 68 PF, 1%, 500V	304-13-06809	06141	600	1	-	
C18	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
K1-K13	RELAY, 3 Form A Contacts	219-98-00013	95073	24MM-3A	13	-	
K14	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
Q1	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q2	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q3	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q4	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
R1	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R2	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF913J	1	-	
R3	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF913J	1	-	
R4	RESISTOR, 510 Ohm, 5%, 1/4W	616-02-51009	01121	RC07GF511J	1	-	
R5	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R6	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R7	RESISTOR, 240 Ohm, 5%, 1/4W	616-02-24009	01121	RC07GF241J	1	-	
R8	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R9	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R10	RESISTOR, 120 Ohm, 5%, 1/4W	616-02-12009	01121	RC07GF121J	1	-	Price and delivery of recommended spares on request.
R11	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R12	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R13	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R14	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	1	-	
R15	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	1	-	
R16	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R17	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R18	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R19	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R20	RESISTOR, 22K, 5%, 1/4W	616-02-22001	01121	RC07GF223J	1	-	
R21	RESISTOR, 22K, 5%, 1/4W	616-02-22001	01121	RC07GF223J	1	-	
R22	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	1	-	
R23	RESISTOR, 11K, 5%, 1/4W	616-02-11001	01121	RC07GF113J	1	-	
R24	RESISTOR, 11K, 5%, 1/4W	616-02-11001	01121	RC07GF113J	1	-	
R25	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R26	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R27	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R28	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R29	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R30	POTENTIOMETER, 200 Ohm, 20%, 1/3W	201-98-00047	01121	NX201M	1	-	
R31	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R32	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R33	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R34	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
	PRINTED WIRING ASSY, Reset Integrator	205-89-00086	06141	6491	1	-	
TP1-4	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	4	-	
C1	CAPACITOR, 15 PF, .5 PF, 500V	304-01-01509	06141	600	1	-	
C2	CAPACITOR, 15 PF, .5 PF, 500V	304-01-01509	06141	600	1	-	
C3	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C4	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C5	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
C6	CAPACITOR, 15 PF, .5 PF, 500V	304-01-01509	06141	600	1	-	Price and delivery of recommended spares on request.
C7	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
C8	CAPACITOR, 33 PF, .5 PF, 500V	304-08-03309	06141	600	1	1	
C9-C11	CAPACITOR, 15 PF, .5 PF, 500V	304-01-01509	06141	600	3	-	
C12	CAPACITOR, 33 PF, .5 PF, 500V	304-08-03309	06141	600	1	-	
C13	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C14	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C15	CAPACITOR, 19 MF, 5%, 35V	321-52-19004	56289	151D196X-5035Z2	1	-	
C16	CAPACITOR, 19 MF, 5%, 35V	321-52-19004	56289	151D196X-5035Z2	1	-	
C17	CAPACITOR, 1.9 MF, 5%, 35V	321-50-19003	56289	151D195X-5035X2	1	-	
C18	CAPACITOR, 1.9 MF, 5%, 35V	321-50-19003	56289	151D195X-5035X2	1	-	
C19	CAPACITOR, .19 MF, 5%, 35V	321-49-19002	56289	151D194X-5035W2	1	-	
C20	CAPACITOR, .19 MF, 5%, 35V	321-49-19002	56289	151D194X-5035W2	1	-	
C21	CAPACITOR, .019 MF, 5%, 35V	321-49-19001	56289	151D193X-5035W2	1	-	
C22	CAPACITOR, .019 MF, 5%, 35V	321-49-19001	56289	151D193X-5035W2	1	1	
C23	CAPACITOR, 2000 PF, 1%, 500V	305-20-20000	06141	600	1	-	
C24	CAPACITOR, 2000 PF, 1%, 500V	305-20-20000	06141	600	1	-	
CR1	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR2	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR3	DIODE	088-99-00169	06141	663	1	-	
CR4	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR5	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR6-CR8	DIODE	088-99-00169	06141	663	3	-	
DL1	DELAY LINE	081-98-00002	[illegible]0222	DP3	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
K1	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	1	-	Price and delivery of recommended spares on request.
K2-K13	RELAY, 2 Form A Contacts	219-98-00012	95073	24MM-2A	12	-	
K14	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
Q1	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q2	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q3-Q6	TRANSISTOR	263-10-39040	JEDEC	2N3904	4	-	
Q7	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q8	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q9	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q10	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q11	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q12	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q13	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q14-Q17	TRANSISTOR	263-10-39060	JEDEC	2N3906	4	-	
Q18	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q19	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q20	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q21	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q22	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q23	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q24	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q25	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q26	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q27	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q28	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
R1	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R2	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R3	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	1	-	
R4	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R5	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R6	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R7	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R8	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	Price and delivery of recommended spares on request.
R9	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R10	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	1	-	
R11	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R12	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R13	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R14	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R15	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R16	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R17	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R18	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R19	POTENTIOMETER, 200 Ohm, 20%, 1/3W	201-98-00047	01121	NX201M	1	-	
R20	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R21	POTENTIOMETER, 200 Ohm, 20%, 1/3W	201-98-00047	01121	NX201M	1	-	
R22	POTENTIOMETER, 500 Ohm, 20%, 1/3W	201-98-00048	01121	NX501M	1	-	
R23	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R24	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R25	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R26	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R27	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R28	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R29	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R30	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R31	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R32	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R33	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R34	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R35	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R36	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	1	-	
R37	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R38	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R39	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R40	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	Price and delivery of recommended spares on request.
R41	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R42	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R43	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R44	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R45	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	1	-	
R46	RESISTOR, 6.8K, 5%, 1/4W	616-02-68000	01121	RC07GF682J	1	-	
R47	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R48	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R49	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R50	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R51	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	1	-	
R52	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R53	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R54	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	1	-	
R55	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R56	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R57	RESISTOR, 100 Ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R58	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	1	-	
R59	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R60	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R61	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R62	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R63	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R64	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R65	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R66	RESISTOR, 1.3K, 5%, 1/4W	616-02-13000	01121	RC07GF132J	1	-	
R67	RESISTOR, 1.3K, 5%, 1/4W	616-02-13000	01121	RC07GF132J	1	-	
R68	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R69	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R70	RESISTOR, 51K, 5%, 1/4W	616-02-51001	01121	RC07GF513J	1	-	
R71	RESISTOR, 51K, 5%, 1/4W	616-02-51001	01121	RC07GF513J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R72	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R73	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R74	RESISTOR, 13K, 5%, 1/4W	616-02-13001	01121	RC07GF133J	1	-	
R75	RESISTOR, 13K, 5%, 1/4W	616-02-13001	01121	RC07GF133J	1	-	
Z1	INTEGRATED CIRCUIT, MC358G/SC1322A	046-16-00002	04713	MC358G/-SC1322A	1	-	
	PRINTED WIRING ASSY, Bit Rate/2 Filter	205-89-00061	06141	6489	1	-	
TP1	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	1	-	
C1	CAPACITOR, 4.7 MF, 5%, 35V	337-05-47003	06141	601	1	-	
C2	CAPACITOR, .47 MF, 5%, 35V	336-05-47002	06141	601	1	-	
C3	CAPACITOR, .047 MF, 5%, 35V	336-05-47001	06141	601	1	-	
C4	CAPACITOR, 4700 PF, 1%, 500V	305-20-47000	06141	600	1	-	
C5	CAPACITOR, 470 PF, 1%, 500V	304-20-47009	06141	600	1	-	
C6	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C7	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C8	CAPACITOR, 3.3 MF, 5%, 35V	337-05-33003	06141	601	1	-	
C9	CAPACITOR, .33 MF, 5%, 35V	336-05-33002	06141	601	1	-	
C10	CAPACITOR .033 MF, 5%, 35V	336-05-33001	06141	601	1	-	
C11	CAPACITOR, 3300 PF, 1%, 500V	305-20-33000	06141	600	1	-	
C12	CAPACITOR, 110 PF, 1%, 500V	304-20-11009	06141	600	1	-	
C13	CAPACITOR, .82 MF, 5%, 35V	336-05-82002	06141	601	1	-	
C14	CAPACITOR, .082 MF, 5%, 35V	336-05-82001	06141	601	1	-	
C15	CAPACITOR, 8200 PF, 1%, 100V	305-62-82000	06141	600	1	-	
C16	CAPACITOR, 820 PF, 1%, 300V	304-41-82009	06141	600	1	-	
C17	CAPACITOR, 22 PF, .5 PF, 500V	304-01-02209	06141	600	1	-	
C18	CAPACITOR, 1000 PF, 1%, 100V	304-62-10000	06141	600	1	-	
K1-K13	RELAY, 3 Form A Contacts	219-98-00013	95073	24MM-3A	13	-	
K14	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
Q1	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q2	TRANSISTOR	263-10-39040	JEDEC	2N3904	1	-	
Q3	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
Q4	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R1	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	Price and delivery of recommended spares on request.
R2	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
R3	RESISTOR, 9 1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
R4	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R5	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R6	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R7	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R8	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R9	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R10	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R11	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R12	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R13	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	1	-	
R14	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	1	-	
R15	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	1	-	
R16	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R17	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R18	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R19	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R20	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R21	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R22	RESISTOR, 11K, 5%, 1/4W	616-02-11001	01121	RC07GF113J	1	-	
R23	RESISTOR, 11K, 5%, 1/4W	616 02-11001	01121	RC07GF113J	1	-	
R24	RESISTOR, 11K, 5%, 1/4W	616 02-11001	01121	RC07GF113J	1	-	
R25	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R26	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R27	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R28	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R29	RESISTOR, 47 Ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R30	POTENTIOMETER, 200 Ohm 20%, 1/3W	201-98-00047	01121	NX201M	1	-	
R31	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R32	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R33	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R34	RESISTOR, 10 Ohm, 5%, 1/4W	616-02-01009	01121	RC07GF101J	1	-	
	PRINTED WIRING ASSY, Phase Shifter	205-89-00062	06141	6493	1	-	
TP1-3	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	3	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2 & C3	CAPACITOR, 91 pf, 1%, 500V	304-20-09109	06141	600	2	1	
C4	CAPACITOR, 47 pf, .5 pf, 500V	304-08-04709	06141	600	1	-	
C5 & C6	CAPACITOR, 1.9 MF, 5%, 35V	321-50-19003	56289	151D195X-5035X2	2	-	
C7 & C8	CAPACITOR, .19 MF, 5%, 35V	321-49-19002	56289	151D194X-5035W2	2	-	
C9 & C10	CAPACITOR, .019 MF, 5%, 35V	321-49-19001	56289	151D193X-5035W2	2	-	
C11 & C12	CAPACITOR, 1900 pf, 1%, 500V	305-20-19000	06141	600	2	1	
C13	CAPACITOR, 150 pf, 1%, 500V	304-20-15009	06141	600	1	-	
C14	CAPACITOR, 190 pf, 1%, 500V	304-20-19009	06141	600	1	-	
C15	CAPACITOR, 47 pf, .5 pf, 500V	304-08-04709	06141	600	1	-	
C16, C17, & C18	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	3	-	
CR1	DIODE	088-99-00189	06141	642-02	1	-	
CR2	DIODE	088-99-00259	06141	642-12	1	-	
K1	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
K2 thru K9	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	8	-	
K10 thru K14	RELAY, 2 Form A Contact	219-98-00012	95073	24MM-2A	5	-	
K15	RELAY, 1 Form B Contact	219-98-00014	95073	24MM-1B	1	-	
K16	RELAY, 1 Form C Contact	219-98-00010	95073	24MM-1C	1	-	
R1 & R2	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	2	-	
R3	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
R4	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R5	RESISTOR, 10.0K, 1%, 1/8W	605-09-10001	06141	625	1	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R6	RESISTOR, 4.99K, 1%, 1/8W	605-09-49900	06141	625	1	-	Price and delivery of recommended spares on request.
R7	RESISTOR, 2.49K, 1%, 1/8W	605-09-24900	06141	625	1	-	
R8	RESISTOR, 1.24K, 1%, 1/8W	605-09-12400	06141	625	1	-	
R9	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R10	RESISTOR, 51K, 5%, 1/4W	616-02-51001	01121	RC07GF513J	1	-	
R11	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R12	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	1	-	
R13	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
R14	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R15	RESISTOR, 619 Ohm, 1%, 1/8W	605-09-61909	06141	625	1	-	
R16	RESISTOR, 1.69K, 1%, 1/8W	605 09-16900	06141	625	1	-	
R17 & R18	RESISTOR, 330 Ohm, 5%, 1W	623-02-33009	01121	RC32GF331J	2	-	
R19	RESISTOR, 330 Ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
Z1	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00007	04713	MC1512	1	1	
Z4 & Z5	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	2	-	
Z6	INTEGRATED CIRCUIT	046-16-00003	04713	MC354G	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00007	04713	MC1512	1	-	
Z8	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	1	-	
Z9 & Z10	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	2	-	
Z11	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z12	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z13	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
	PRINTED WIRING ASSY, Bit Decision	205-89-00063	06141	6495	1	-	
	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	4	-	
C1	CAPACITOR, 3 pf, .5 pf, 500V	304-01-00309	06141	600	1	-	
C2	CAPACITOR, 15 pf, .5 pf, 500V	304-01-01509	06141	600	1	-	
C3	CAPACITOR, 1000 pf, 1%, 100V	304-62-10000	06141	600	1	-	
C4	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C5	CAPACITOR, 2000 pf, 1%, 500V	305-20-20000	06141	600	1	-	
C6 thru C12	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	7	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
C13	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	Price and delivery of recommended spares on request.
C14	CAPACITOR, 47 pf, .5 pf, 500V	304-08-04709	06141	600	1	-	
C15	CAPACITOR, 68 pf, 1%, 500V	304-13-06809	06141	600	1	-	
CR1	DIODE	088-99-00259	06141	642-12	1	-	
CR2	DIODE	088-99-00169	06141	663	1	-	
CR3	DIODE	088-99-00169	06141	663	1	-	
CR4	DIODE	088-99-00159	06141	636	1	-	
CR5	DIODE	088-99-00159	06141	636	1	-	
R1	RESISTOR, 10.0K, 1%, 1/8W	605-09-10001	06141	625	1	-	
R2 & R3	RESISTOR, 4.99K, 1%, 1/8W	605-09-49900	06141	625	2	-	
R4	RESISTOR, 10.0K, 1%, 1/8W	605-09-10001	06141	625	1	-	
R5	RESISTOR, 100 ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R6	RESISTOR, 2.49K, 1%, 1/8W	605-09-24900	06141	625	1	-	
R7	RESISTOR, 4.99K, 1%, 1/8W	605-09-49900	06141	625	1	-	
R8	RESISTOR, 47 ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	1	-	
R9	RESISTOR, 2.49K, 1%, 1/8W	605-09-24900	06141	625	1	-	
R10	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RCO7GF392J	1	-	
R11	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
R12	RESISTOR, 270 ohm, 5%, 1W	623-02-27009	01121	RC32GF271J	1	-	
R13 & R14	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	2	-	
R15	RESISTOR, 150 ohm, 5%, 1/4W	616-02-15009	01121	RC07GF151J	1	-	
R16 thru R20	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	5	-	
R21	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R22	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	1	-	
Z1 & Z2	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	2	-	
Z3 & Z4	INTEGRATED CIRCUIT	046-18-00006	07263	U5B771239X	2	-	
Z5	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z8	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z9	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z10	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z11	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	Price and delivery of recommended spares on request.
Z12 thru Z14	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	3	-	
Z15	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z16	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z17	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z18	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z19	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z20	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z21	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z22 thru Z24	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	3	-	
Z25	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z26	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z27 & Z28	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	2	-	
Z29	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
	PRINTED WIRING ASSY, Negative Counter	205-89-00064	06141	6497	1	-	
TP1 thru TP3	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	3	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2 thru C8	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	7	-	
C9 thru C11	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	3	-	
C12 thru C19	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	8	-	
CR1	DIODE	088-99-00259	06141	642-12	1	-	
CR2	DIODE	088-99-00209	06141	642-10	1	-	
CR3	DIODE	088-99-00169	06141	663	1	-	
Q1 thru Q17	TRANSISTOR	263-10-35650	JEDEC	2N3565	17	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R1 thru R4	RESISTOR, 3.32K, 1%, 1/8W	605-09-33200	06141	625	4	-	Price and delivery of recommended spares on request.
R5	RESISTOR, 680 ohm, 5%, 1/2W	622-02-68009	01121	RC20GF681K	1	-	
R6	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R7	RESISTOR, 16K, 5%, 1/4W	616-02-16001	01121	RC07GF163J	1	-	
R8 thru R10	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	3	-	
R11	RESISTOR, 402K, 1%, 1/8W	605-09-40202	06141	625	1	-	
R12	RESISTOR, 200K, 1%, 1/8W	605-09-20002	06141	625	1	-	
R13	RESISTOR, 100K, 1%, 1/8W	605-09-10002	06141	625	1	-	
R14 thru R19	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	5	-	
R20 & R21	RESISTOR, 10 ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	2	-	
R22	RESISTOR, 1.6K, 5%, 1/4W	616-02-16000	01121	RC07GF162J	1	-	
R23 thru R30	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	8	-	
R31	RESISTOR, 3.16K, 1%, 1/8W	605-09-31600	06141	625	1	-	
R32	RESISTOR, 6.19K, 1%, 1/8W	605-09-61900	06141	625	1	-	
R33	RESISTOR, 12.4K, 1%, 1/8W	605-09-12401	06141	625	1	-	
R34	RESISTOR, 24.9K, 1%, 1/8W	605-09-24901	06141	625	1	-	
R35	RESISTOR, 49.9K, 1%, 1/8W	605-09-49901	06141	625	1	-	
Z1	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z4	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z8	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z9	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z10	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z11 thru Z14	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	4	-	Price and delivery of recommended spares on request.
Z15	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z16	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z17	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z18	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z19	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z20	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z21	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z22	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z23	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z24	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z25	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z26	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z27	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
	PRINTED WIRING ASSY, Positive Counter.	205-89-00065	06141	6499	1	-	
TP1	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	1	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2 thru C19	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	18	-	
CR1	DIODE	088-99-00259	06141	642-12	1	-	
CR2	DIODE	088-99-00279	06141	642-01	1	-	
CR3	DIODE	088-99-00169	06141	663	1	-	
CR4	DIODE	088-99-00209	06141	642-10	1	-	
Q1 thru Q18	TRANSISTOR	263-10-35650	JEDEC	2N3565	18	-	
R1 thru R4	RESISTOR, 3.32K, 1%, 1/8W	605-09-33200	06141	625	4	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R5	RESISTOR, 680 ohm, 5%, 1/2W	622-02-68009	01121	RC20GF681J	1	-	Price and delivery of recommended spares on request.
R6	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R7	RESISTOR, 16K, 5%, 1/4W	616-02-16001	01121	RC07GF163J	1	-	
R8	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R9 & R10	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	2	-	
R11	RESISTOR, 402K, 1%, 1/8W	605-09-40202	06141	625	1	-	
R12	RESISTOR, 200K, 1%, 1/8W	605-09-20002	06141	625	1	-	
R13	RESISTOR, 100K, 1%, 1/8W	605-09-10002	06141	625	1	-	
R14 thru R19	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	6	-	
R20 & R21	RESISTOR, 10 ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	2	-	
R22	RESISTOR, 1.6K, 5%, 1/4W	616-02-16000	01121	RC07GF162J	1	-	
R23 thru R30	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	8	-	
R31	RESISTOR, 3.16K, 1%, 1/8W	605-09-31600	06141	625	1	-	
R32	RESISTOR, 6.19K, 1%, 1/8W	605-09-61900	06141	625	1	-	
R33	RESISTOR, 12.4K, 1%, 1/8W	605-09-12401	06141	625	1	-	
R34	RESISTOR, 24.9K, 1%, 1/8W	605-09-24901	06141	625	1	-	
R35	RESISTOR, 49.9K, 1%, 1/8W	605-09-49901	06141	625	1	-	
R36 & R37	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	2	-	
R38	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
Z1	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z4	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z8	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z9	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z10	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	Price and delivery of recommended spares on request.
Z11 thru Z14	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	4	-	
Z15	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z16	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z17	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z18	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z19	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z20	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z21	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z22	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z23	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z24	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z25	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z26	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z27	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
	PRINTED WIRING ASSY, Loop Resistor	205-89-00250	06141	13160	1	-	
TP1 thru TP4	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	4	-	
C1 thru C4	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	4	-	
C5	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	1	-	
CR1 thru CR4	DIODE	088-99-00159	06141	636	4	-	
CR5 & CR6	DIODE	088-99-00289	06141	910	2	1	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
CR7 & CR8	DIODE	088-99-00159	06141	636	2	-	Price and delivery of recommended spares on request.
K1 & K2	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	2	-	
K3 thru K6	RELAY, 4 Form A Contacts	219-98-00015	95073	24MM-4A	4	1	
K7 thru K14	RELAY, 2 Form A Contacts	219-98-00012	95073	24MM-2A	8	-	
Q1 & Q2	TRANSISTOR	263-10-35660	JEDEC	2N3566	2	-	
R1	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R2	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R3	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R4	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R5 & R6	RESISTOR, 10.0K, 1%, 1/8W	605-09-10001	06141	625	2	-	
R7	RESISTOR, 20.5K, 1%, 1/8W	605-09-20501	06141	625	1	-	
R8 & R9	RESISTOR, 360 ohm, 5%, 1/4W	616-02-36009	01121	RC07GF361J	2	-	
R10	RESISTOR, 200 ohm, 5%, 1/4W	616-02-20009	01121	RC07GF201J	1	-	
R11	RESISTOR, 680 ohm, 5%, 1/4W	616-02-68009	01121	RC07GF681J	1	-	
R12	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	1	-	
R13	RESISTOR, 390K, 5%, 1/4W	616-02-39002	01121	RC07GF394J	1	-	
R14	RESISTOR, 820K, 5%, 1/4W	616-02-82002	01121	RC07GF824J	1	-	
R15	RESISTOR, 1.6 Meg, 5%, 1/4W	616-02-16003	01121	RC07GF165J	1	-	
R16	RESISTOR, 3.3 Meg, 5%, 1/4W	616-02-33003	01121	RC07GF335J	1	-	
R17	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF755J	1	-	
R18 & R19	RESISTOR, 560 ohm, 5%, 1/4W	616-02-56009	01121	RC07GF561J	2	-	
R20	RESISTOR, 5.6K, 5%, 1/4W	616-02-56000	01121	RC07GF562J	1	-	
R21 & R22	RESISTOR, 49.9K, 1%, 1/8W	605-09-49901	06141	625	2	-	
R23	RESISTOR, 1K, 1%, 1/8W	605-09-10000	06141	625	1	-	
R24	RESISTOR, 15K, 5%, 1/4W	616-02-15001	01121	RC07GF153J	1	-	
R25	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	1	-	
R26	RESISTOR, 3.6K, 5%, 1/4W	616-02-36000	01121	RC07GF362J	1	-	
R27	RESISTOR, 1.8K, 5%, 1/4W	616-02-18000	01121	RC07GF182J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R28	RESISTOR, 150K, 5%, 1/4W	616-02-15002	01121	RC07GF154J	1	-	Price and delivery of recommended spares on request.
R29	RESISTOR, 75K, 5%, 1/4W	616-02-75001	01121	RC07GF753J	1	-	
R30	RESISTOR, 36K, 5%, 1/4W	616-02-36001	01121	RC07GF363J	1	-	
R31	RESISTOR, 18K, 5%, 1/4W	616-02-18001	01121	RC07GF183J	1	-	
R32	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R33	RESISTOR, 20K, 5%, 1/4W	616-02-20001	01121	RC07GF203J	1	-	
R34	RESISTOR, 68K, 5%, 1/4W	616-02-68001	01121	RC07GF683J	1	-	
R35	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R36	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R37	RESISTOR, 33K, 5%, 1/4W	616-02-33001	01121	RC07GF333J	1	-	
R38	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R39	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R40	RESISTOR, 16K, 5%, 1/4W	616-02-16001	01121	RC07GF163J	1	-	
R41	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	1	-	
R42	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R43	RESISTOR, 8.2K, 5%, 1/4W	616-02-82000	01121	RC07GF822J	1	-	
R44	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R45	RESISTOR, 200K, 5%, 1/4W	616-02-20002	01121	RC07GF204J	1	-	
R46	RESISTOR, 680K, 5%, 1/4W	616-02-68002	01121	RC07GF684J	1	-	
R47	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	1	-	
R48	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R49	RESISTOR, 330K, 5%, 1/4W	616-02-33002	01121	RC07GF334J	1	-	
R50	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R51	RESISTOR, 51K, 5%, 1/4W	616-02-51001	01121	RC07GF513J	1	-	
R52	RESISTOR, 160K, 5%, 1/4W	616-02-16002	01121	RC07GF164J	1	-	
R53	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	1	-	
R54	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	1	-	
R55	RESISTOR, 82K, 5%, 1/4W	616-02-82001	01121	RC07GF823J	1	-	
R56	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R57	RESISTOR, 1K, 1%, 1/8W	605-09-10000	06141	625	1	-	
R58	POTENTIOMETER, 500 ohm, 20%, 1/3W	201-98-00048	01121	NX501M	1	-	
R59	POTENTIOMETER, 1K, 20%, 1/3W	201-98-00049	01121	NX102M	1	-	
R60	RESISTOR, 750 ohm, 5%, 1/4W	616-02-75009	01121	RC07GF754J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z1	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	Price and delivery of recommended spares on request.
Z2	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z4	INTEGRATED CIRCUIT	046-28-00001	17276	SK-2	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
	PRINTED WIRING ASSY, Loop Capacitor	205-89-00067	06141	6503	1	-	
C1	CAPACITOR, 120 MF, 10%, 10V	359-08-12005	56289	130D127X-9010F2	1	-	
C2	CAPACITOR. 1200 MF, 10%, 4V	359-02-12006	56289	130D128X-9004W2	1	-	
C3	CAPACITOR, 12 MF, 10%, 10V	337-11-12004	06141	601	1	-	
C4	CAPACITOR, 120 MF, 10%, 10V	359-08-12005	56289	130D127X-9010F2	1	-	
C5	CAPACITOR, 1.2 MF, 5%, 35V	337-05-12003	06141	601	1	-	
C6	CAPACITOR, 12 MF, 10%, 10V	337-11-12004	06141	601	1	1	
C7	CAPACITOR, .12 MF, 10%, 35V	336-14-12002	06141	601	1	-	
C8	CAPACITOR, 1.2 MF, 5%, 35V	337-05-12003	06141	601	1	-	
C9	CAPACITOR, .012 MF, 10%, 35V	336-14-12001	06141	601	1	-	
C10	CAPACITOR, .12 MF, 10%, 35V	336-14-12002	06141	601	1	-	
C11	CAPACITOR, 1200 pf, 1%, 500V	305-20-12000	06141	600	1	-	
C12	CAPACITOR, .012 MF, 10%, 35V	336-14-12001	06141	601	1	-	
C13	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	1	-	
C14	CAPACITOR, 1200 pf, 1%, 500 V	305-20-12000	06141	600	1	-	
CR1 thru CR10	DIODE	088-99-00159	06141	636	10	-	
CR11	DIODE	088-99-00169	06141	663	1	-	
CR12	DIODE	088-99-00169	06141	663	1	-	
K1 thru K11	RELAY, 2 Form A contacts	219-98-00012	95073	24MM-2A	11	-	
R1	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R2 thru R13	RESISTOR, 1 Meg, 5%, 1/4W	616-02-10003	01121	RC07GF105J	12	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	PRINTED WIRING ASSY, Divider	205-89-00068	06141	6505	1	-	Price and delivery of recommended spares on request.
TP1 thru TP6	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	6	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
Z1	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z4 thru Z6	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	3	-	
Z7	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z8 thru Z23	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	16	-	
	PRINTED WIRING ASSY, VCO	205-89-00252	06141	13215	1	-	
TP1 and TP2	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	2	-	
C1 thru C4	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	4	-	
C5	CAPACITOR, 1000 pf, 2%, 100V	304-61-10000	06141	600	1	-	
C6 & C7	CAPACITOR, 98 pf, 1%, 500V	304-20-09809	06141	600	2	1	
C8	CAPACITOR, 1000 pf, 2%, 100V	304-61-10000	06141	600	1	-	
CR1 thru CR8	DIODE	088-99-00159	06141	636	8	-	
CR9	DIODE	088-99-00129	06141	642-05	1	1	
CR10	DIODE	088-99-00159	06141	636	1	-	
CR11	DIODE	088-99-00129	06141	642-05	1	-	
CR12	DIODE	088-99-00159	06141	636	1	-	
K1 thru K12	RELAY, 2 Form A Contacts	219-98-00012	95073	24MM-2A	12	-	
Q1	TRANSISTOR	263-10-36380	JEDEC	2N3638	1	-	
Q2	TRANSISTOR	263-99-00129	06141	935	1	-	
Q3 & Q4	TRANSISTOR	263-10-32270	JEDEC	2N3227	2	1	
Q5	TRANSISTOR	263-99-00129	06141	935	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Q6 & Q7	TRANSISTOR	263-10-36380	JEDEC	2N3638	2	-	Price and delivery of recommended spares on request.
R1 & R2	RESISTOR, 40K, .1%, 1/8W	605-12-40001	06141	625	2	1	
R3 & R4	RESISTOR, 20K, .1%, 1/8W	605-12-20001	06141	625	2	1	
R5 & R6	RESISTOR, 10K, .1%, 1/8W	605-12-10001	06141	625	2	1	
R7 & R8	RESISTOR, 5K, .1%, 1/8W	605-12-50000	06141	625	2	1	
R9 & R10	RESISTOR, 402 K, 1%, 1/8W	605-09-40202	06141	625	2	-	
R11 & R12	RESISTOR, 200K, 1%, 1/8W	605-09-20002	06141	625	2	-	
R13 & R14	RESISTOR, 100K, 1%, 1/8W	605-09-10002	06141	625	2	-	
R15 & R16	RESISTOR, 49.9K, 1%, 1/8W	605-09-49901	06141	625	2	-	
R17 & R18	RESISTOR, 3.9 Meg, 5%, 1/4W	616-02-39003	01121	RC07GF395J	2	-	
R19 & R20	RESISTOR, 2 Meg, 5%, 1/4W	616-02-20003	01121	RC07GF205J	2	-	
R21 & R22	RESISTOR, 1 Meg, 5%, 1/4W	616-02-10003	01121	RC07GF105J	2	-	
R23 & R24	RESISTOR, 510K, 5%, 1/4W	616-02-51002	01121	RC07GF514J	2	-	
R25 & R26	RESISTOR, 10 ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	2	-	
R27	RESISTOR, 180 ohm, 5%, 1W	623-02-18009	01121	RC32GF181J	1	-	
R28 & R29	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	2	-	
R30	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	1	-	
R31	RESISTOR, 5.62K, 1%, 1/8W	605-09-56200	06141	625	1	-	
R32	RESISTOR, 4.3K, 5%, 1/4W	616-02-43000	01121	RC07GF432J	1	-	
R33 & R34	RESISTOR, 15 ohm, 5%, 1/4W	616-02-01509	01121	RC07GF150J	2	-	
R35	RESISTOR, 4.3K, 5%, 1/4W	616-02-43000	01121	RC07GF432J	1	-	
R36	RESISTOR, 5.62K, 1%, 1/8W	605-09-56200	06141	625	1	-	
R37	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	1	-	
R38	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	1	-	
R39	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R40	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	1	-	
R41	RESISTOR, 1.82K, 1%, 1/8W	605-09-18200	06141	625	1	1	
R42	POTENTIOMETER, 20 ohm, 5%, 1W	201-98-00046	07716	201-10	1	-	
R43	RESISTOR, 1.82K, 1%, 1/8W	605-09-18200	06141	625	1	-	
R44 thru R47	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	4	-	
R48	RESISTOR, 330 ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z1	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z4	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
	PRINTED WIRING ASSY, S Phase Clock Reset	205-89-00361	06141	14925	1	-	
TP1 thru TP4	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	4	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C2 thru C16	CAPACITOR, 120 pf, 2%, 500V	304-20-12009	06141	600	15	-	
R2 thru R17	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	16	-	
Z1	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z3 & Z4	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	2	-	
Z5	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z7	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z8	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z9	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z10	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z11	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z12	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z13	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z14	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z15	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	Price and delivery of recommended spares on request.
Z16	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z17 & Z18	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	2	-	
Z19	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1	-	
Z20	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z21	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z22	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z23 thru Z27	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	5	-	
Z28 thru Z31	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z32 thru Z34	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	3		
Z35	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	1		
	PRINTED WIRING ASSY, Loss Lock & Counter	205-89-00071	06141	6511	1	-	
TP1 thru TP5	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	5	-	
C1 thru C3	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	3	-	
C4	CAPACITOR, 1200 MF, 10%, 4V	359-02-12006	56289	130D128X-9004W2	1	-	
C5	CAPACITOR, 100 MF, 10%, 10V	338-11-10005	06141	601	1	-	
C6	CAPACITOR, 10 MF, 20%, 15V	337-21-10004	06141	601	1	-	
C7	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C8	CAPACITOR, .1 MF, 20%, 35V	336-23-10002	06141	601	1	-	
C9	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
C10 & C11	CAPACITOR, 120 pf, 1%, 500V	304-20-12009	06141	600	2	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
C12	CAPACITOR, 47 pf, .5 pf, 500V	304-08-04709	06141	600	1	-	
CR1	DIODE	088-99-00259	06141	642-12	1	-	
CR2	DIODE	088-99-00199	06141	642-06	1	-	
CR3 & CR4	DIODE	088-99-00169	06141	663	2	-	
K1 thru K5	RELAY, 1 Form A Contact	219-98-00011	95073	24MM-1A	5	-	
Q1 & Q2	TRANSISTOR	263-10-35660	JEDEC	2N3566	2	-	
R1	RESISTOR, 10 ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	1	-	
R2	RESISTOR, 330 ohm, 5%, 1W	623-02-33009	01121	RC07GF331J	1	-	
R3	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R4	RESISTOR, 5.6K, 5%, 1/4W	616-02-56000	01121	RC07GF562J	1	-	
R5	RESISTOR, 200 ohm, 5%, 1/4W	616-02-20009	01121	RC07GF201J	1	-	
R6	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R7	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	1	-	
R8	POTENTIOMETER, 500 ohm, 10%, 1W	201-98-00014	02660	2600P-501 BS1066	1	-	
R9 & R10	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	2	-	
R11	RESISTOR, 680 ohm, 5%, 1/4W	616-02-68009	01121	RC07GF681J	1	-	
R12	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
Z1	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z2	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z3	INTEGRATED CIRCUIT	046-16-00009	04713	MC367G	1	-	
Z4	INTEGRATED CIRCUIT	046-18-00006	07263	U5B771239X	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z6 thru Z9	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	4	-	
Z10	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	1	-	
Z11 thru Z13	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G/ SC1322A	3	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z14	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	1	-	
Z15	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
	PRINTED WIRING ASSY, Output Amplifier	205-89-00106	06141	11413	1	-	
TP1	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	1	-	
C1 thru C4	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	4	-	
CR1 thru CR3	DIODE	088-99-00169	06141	663	3	-	
CR4	DIODE	088-10-38260	JEDEC	1N3826	1	-	
Q1 & Q2	TRANSISTOR	263-10-39040	JEDEC	2N3904	2	-	
Q3	TRANSISTOR	263-10-39060	JEDEC	2N3906	1	-	
R1	RESISTOR, 100 ohm, 5%, 1/4W	616-02-10009	01121	RC07GF101J	1	-	
R2	RESISTOR, 330 ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	1	-	
R3 thru R6	RESISTOR, 100 ohm, 5%, 1/4W	616-02-10009	06141	623	4	-	
R7	RESISTOR, 2.7K, 5%, 1/4W	616-02-27000	01121	RC07GF272J	1	-	
R8 thru R15	RESISTOR, 43 ohm, 5%, 1/4W	616-02-04309	01121	RC07GF430J	8	1	
Z1 thru Z6	INTEGRATED CIRCUIT	046-14-00006	93332	SG-142-03	6	1	
Z7	INTEGRATED CIRCUIT	046-16-00009	04713	MC367G	1	-	
Z8 thru Z10	INTEGRATED CIRCUIT	046-14-00017	93332	SG-42-03	3	1	
Z11	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z12 thru Z14	INTEGRATED CIRCUIT	046-16-00009	04713	MC367G	3	-	
	PRINTED WIRING ASSY, Control Card #1	205-89-00078	06141	11384	1	-	
C1	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	1	-	
CR1	DIODE	088-99-00199	06141	642-06	1	-	
CR2 thru CR9	DIODE	088-99-00159	06141	636	8	-	
Q1	TRANSISTOR	263-10-30540	JEDEC	2N3054	1	-	
Q2 thru Q9	TRANSISTOR	263-10-35660	JEDEC	2N3566	8	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R1	RESISTOR, 470 ohm, 10%, 2W	624-03-47009	01121	RC42GF471K	1	-	Price and delivery of recommended spares on request.
R2 thru R9	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	8	-	
R11 thru R18	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	8	-	
Z1 thru Z4	INTEGRATED CIRCUIT	046-14-00006	93332	SG-142-03	4	-	
Z5 & Z6	INTEGRATED CIRCUIT	046-14-00016	93332	SM-73-03	2	-	
Z7 thru Z9	INTEGRATED CIRCUIT	046-14-00001	93332	SG-43-03	3	-	
Z10	INTEGRATED CIRCUIT	046-14-00006	93332	SG-142-03	1	-	
	PRINTED WIRING ASSY, Control Card #2	205-89-00079	06141	11382	1	-	
C1 & C2	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	2	-	
CR1	DIODE	088-99-00199	06141	642-06	1	-	
CR2 thru CR10	DIODE	088-99-00159	06141	636	9	-	
Q1	TRANSISTOR	263-10-30540	JEDEC	2N3054	1	-	
Q2 to Q10	TRANSISTOR	263-10-35660	JEDEC	2N3566	9	-	
R1	RESISTOR, 470 ohm, 10%, 2W	624-03-47009	01121	RC42GF471K	1	-	
R2	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R3	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R4	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R5	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R6	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R7	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R8	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R9	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R10	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R11	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	1	-	
R12 thru R15	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	4	-	
R16	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R17	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF302J	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R18	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	Price and delivery of recommended spares on request.
R19	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R20	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R21	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R22	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R23	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R24	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	1	-	
R25	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	1	-	
R26 thru R29	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	4	-	
Z1 thru Z3	INTEGRATED CIRCUIT	046-14-00016	93332	SM-73-03	3	-	
Z4 thru Z6	INTEGRATED CIRCUIT	046-14-00006	93332	SG-142-03	3	-	
Z7 thru Z9	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	3	-	
Z10	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
	PRINTED WIRING ASSY, Control Card #3	205-89-00080	06141	11380	1	-	
C1 & C2	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	2	-	
CR1	DIODE	088-10-47331	JEDEC	1N4733A	1	-	
CR2 & CR3	DIODE	088-99-00159	06141	636	2	-	
Q1 & Q2	TRANSISTOR	263-10-35660	JEDEC	2N3566	2	-	
R1	RESISTOR, 120 ohm, 10%, 2W	624-03-12009	01121	RC42GF121K	1	-	
R2	RESISTOR, 270 ohm, 5%, 1/4W	616-02-27009	01121	RC07GF271J	1	-	
R3 thru R18	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	16	-	
R19	RESISTOR, 6.2K, 5%, 1/4W	616-02-62000	01121	RC07GF622J	1	-	
R20	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
R21	RESISTOR, 5.2K, 5%, 1/4W	616-02-62000	01121	RC07GF622J	1	-	
R22	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	1	-	
Z1 & Z2	INTEGRATED CIRCUIT	046-14-00016	93332	SM-73-03	2	-	
Z3	INTEGRATED CIRCUIT	046-16-00003	93332	MC360G	1	-	

Table 6-1 (Cont'd). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
Z4	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
Z5	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	1	-	
Z6	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
Z7 & Z8	INTEGRATED CIRCUIT	046-16-00009	04713	MC367G	2	-	
Z9	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	1	-	
	PRINTED WIRING ASSY, Control Card #4	205-89-00081	06141	11378	1	-	
C1 & C2	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	2	-	
CR1	DIODE	088-99-00199	06141	642-06	1	-	
CR2 thru CR5	DIODE	088-99-00159	06141	636	4	-	
Q1	TRANSISTOR	263-10-30540	JEDEC	2N3054	1	-	
Q2 thru Q5	TRANSISTOR	263-10-35660	JEDEC	2N3566	4	-	
R1	RESISTOR, 470 ohm, 10%, 2W	624-03-47009	01121	RC42GF471K	1	-	
R2 & R3	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	2	-	
R4 & R5	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	2	-	
R6 & R7	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	2	-	
R8 thru R11	RESISTOR, 3.3K, 5%, 1/4W	616-02-33000	01121	RC07GF332J	4	-	
R12 & R13	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	2	-	
R14 & R15	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	2	-	
R16 & R17	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	2	-	
R18 thru R21	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	4	-	
Z1 thru Z3	INTEGRATED CIRCUIT	046-14-00016	93332	SM-73-03	3	-	
Z4 & Z5	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	2	-	
Z6	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	1	-	
	PRINTED WIRING ASSY, Regulator	205-89-00251	06141	13163	1	-	
TP1 thru TP8	JACK, Test Point, Red	143-98-00017	00779	3-582340-2	8	-	
C1	CAPACITOR, .22 MF, 20%, 35V	336-23-22002	06141	601	1	-	

Price and delivery of recommended spares on request.

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
C2	CAPACITOR, 750 MF, -10 75%, 25V	354-30-75005	56289	39D-757-G-025-GJ-4	1	1	Price and delivery of recommended spares on request.
C3	CAPACITOR, .02 MF, 10%, 100V	361-01-20001	06141	809	1	1	
C4	CAPACITOR, 750 MF, -10 75%, 25V	354-30-75005	56289	39D-757-G-025-GJ-4	1	-	
C5	CAPACITOR, .02 MF, 10%, 100V	361-01-20001	06141	809	1	-	
C6 & C7	CAPACITOR, 750 MF, -10 75%, 25V	354-30-75005	56289	39D-757-G-025-GJ-4	2	-	
CR1	DIODE	088-10-47471	JEDEC	1N4747A	1	-	
CR2	DIODE	088-99-00099	06141	642-00	1	-	
CR3	DIODE	088-99-00119	06141	642-13	1	-	
CR4	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR5	DIODE	088-10-32540	JEDEC	1N3254	1	1	
CR6	DIODE	088-99-00099	06141	642-00	1	-	
CR7	DIODE	088-99-00119	06141	642-13	1	-	
CR8	DIODE	088-10-09360	JEDEC	1N936	1	-	
CR9	DIODE	088-10-32540	JEDEC	1N3254	1	-	
CR10	DIODE	088-10-47491	JEDEC	1N4749A	1	-	
Q1	TRANSISTOR	263-15-00019	02735	40250	1	1	
Q2 thru Q6	TRANSISTOR	263-10-35650	JEDEC	2N3565	5	-	
Q7	TRANSISTOR	263-10-36380	JEDEC	2N3638	1	-	
Q8	TRANSISTOR	263-10-35650	JEDEC	2N3565	1	-	
Q9	TRANSISTOR	263-15-00019	02735	40250	1	-	
Q10 thru Q12	TRANSISTOR	263-10-35650	JEDEC	2N3565	3	-	
Q13	TRANSISTOR	263-10-36380	JEDEC	2N3638	1	-	
Q14	TRANSISTOR	263-10-3565	JEDEC	2N3565	1	-	
Q15	TRANSISTOR	263-15-00019	02735	40250	1	-	
Q16 thru Q18	TRANSISTOR	263-10-35650	JEDEC	2N3565	3	-	
R1	RESISTOR, 56 ohm, 5%, 1/4W	616-02-05609	01121	RC07GF560J	1	-	
R2 & R3	RESISTOR, 1 ohm, 3%, 3W	626-01-00109	06141	621	2	1	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R4	RESISTOR, 220 ohm, 5%, 1/4W	616-02-22009	01121	RC07GF221J	1	-	Price and delivery of recommended spares on request.
R5	RESISTOR, 1.6K, 5%, 1/4 W	616-02-16000	01121	RC07GF162J	1	-	
R6	RESISTOR, 11K, 5%, 1/4W	616-02-11001	01121	RC07GF113J	1	-	
R7	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	1	-	
R8	RESISTOR, 3.32K, 1%, 1/8W	605-09-33200	06141	625	1	-	
R9 & R10	RESISTOR, 27K, 5%, 1/4W	616-02-27001	01121	RC07GF273J	2	-	
R11	RESISTOR, 237 ohm, 1%, 1/8W	605-09-23709	06141	625	1	-	
R12	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	1	-	
R13	RESISTOR, 1.47K, 1%, 1/8W	605-09-14700	06141	625	1	-	
R14 & R15	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	2	-	
R16	RESISTOR, 1.87K, 1%, 1/8W	605-09-18700	06141	625	1	-	
R17	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	1	-	
R18	RESISTOR, 390 ohm, 5%, 1/4W	616-02-39009	01121	RC07GF391J	1	-	
R19	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R20	POTENTIOMETER, 1K, 10%, 1W	201-98-00015	02660	2600P-102 BS1066	1	-	
R21	RESISTOR, 681 ohm, 1%, 1/8W	605-09-68109	06141	625	1	-	
R22	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	1	-	
R23	POTENTIOMETER, 200 ohm, 10%, 1W	201-98-00029	02660	2600P-201 BS1066	1	-	
R24	RESISTOR, 562 ohm, 1%, 1/8W	605-09-56209	06141	625	1	-	
R25	RESISTOR, 2.4K, 5%, 1W	623-02-24000	01121	RC07GF242J	1	-	
R26	RESISTOR, 150 ohm, 5%, 1/4W	616-02-15009	01121	RC07GF151J	1	-	
R27	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	1	-	
R28& R29	RESISTOR, 1 ohm, 3%, 3W	626-01-00109	06141	621	2	-	
R30	POTENTIOMETER, 1K, 10%, 1W	201-98-00015	02660	2600P-102 BS1066	1	-	
R31	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	1	-	
R32	RESISTOR, 8.2K, 5%, 1/4W	616-02-82000	01121	RC07GF822J	1	-	
R33	RESISTOR, 3.6K, 5%, 1/4W	616-02-36000	01121	RC07GF362J	1	-	
R34	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R35	POTENTIOMETER, 500 ohm, 10%, 1W	201-98-00014	02660	2600P-501 BS1066	1	-	

Table 6-1 (Cont'd.). Model 2721 Parts List

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
R36	RESISTOR, 1.47K, 1%, 1/8W	605-09-14700	06141	625	1	1	Price and delivery of recommended spares on request.
R37	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	1	-	
R38	RESISTOR, 1.47K, 1%, 1/8W	605-09-14700	06141	625	1	-	
R39 & R40	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	2	-	
R41	RESISTOR, 1.87K, 1%, 1/8W	605-09-18700	06141	625	1	1	
R42	RESISTOR, 120 ohm, 5%, 1W	623-02-12009	01121	RC07GF121J	1	-	
R43	RESISTOR, 2.4K, 5%, 1W	623-02-24000	01121	RC07GF242J	1	-	
R44	RESISTOR, 150 ohm, 5%, 1/4W	616-02-15009	01121	RC07GF151J	1	-	
R45	RESISTOR, 1.8K, 5%, 1/4W	616-02-18000	01121	RC07GF182J	1	-	
R46 & R47	RESISTOR, 1 ohm, 3%, 3W	626-01-00109	06141	621	2	-	
R48	POTENTIOMETER, 1K, 10%, 1W	201-98-00015	02660	2600P-102 BS1066	1	-	
R49	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	1	-	
R50	RESISTOR, 8.2K, 5%, 1/4W	616-02-82000	01121	RC07GF822J	1	-	
R51	RESISTOR, 3.6K, 5%, 1/4W	616-02-36000	01121	RC07GF362J	1	-	
R52	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	1	-	
R53	POTENTIOMER, 500 ohm, 10%, 1W	201-98-00014	02660	2600P-501 BS1066	1	-	
R54	RESISTOR, 1.47K, 1%, 1/8W	605-09-14700	06141	625	1	-	

Table 6-2. List of Model 2721 Multi-Used Parts and Recommended Spares

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	CAPACITOR, 0.012 MF, 10%, 35V	336-05-12002	06141	601	3	1	
	CAPACITOR, 0.019 MF, 5%, 35V	321-49-19001	56289	151D193X503-5W2	4	1	
	CAPACITOR, 0.02 MF, 10%, 100V	361-01-20001	06141	809	2	1	
	CAPACITOR, 0.12 MF, 10%, 35V	336-14-12002	06141	601	3	1	
	CAPACITOR, 1.0 MF, 20%, 35V	336-23-10003	06141	601	53	5	
	CAPACITOR, 1.9 MF, 5%, 35V	321-50-19003	56289	151D195X50-35X2	4	1	
	CAPACITOR, 100 MF, 10%, 10V	339-22-10005	06141	601	4	1	
	CAPACITOR, 1200 MF, 10%, 4V	359-02-12006	56289	130D128X-9004W2	2	1	
	CAPACITOR, 15 MF, 5%, 500V	304-01-01509	06141	600	7	1	
	CAPACITOR, 47 MF, 2%, 500V	304-08-04709	06141	600	4	1	
	CAPACITOR, 68 MF, 2%, 500V	304-13-06809	06141	600	2	1	
	CAPACITOR, 100 MF, 2%, 500V	304-20-10009	06141	600	2	1	
	CAPACITOR, 120 MF, 2%, 500V	304-20-12009	06141	600	55	6	
	CAPACITOR, 1000 MF, 2%, 100V	304-62-10000	06141	600	13	2	
	CAPACITOR, 1200 MF, 2%, 500V	305-20-12000	06141	600	3	1	
	CAPACITOR, 2000 MF, 1%, 500V	305-20-20000	06141	600	3	1	
	CAPACITOR, 4700 MF, 2%, 500V	305-20-47000	06141	600	3	1	
	DIODE	088-99-00159	06141	636	52	5	
	DIODE	088-99-00209	06141	642-10	2	1	
	DIODE	088-99-00259	06141	642-12	7	1	
	DIODE	088-99-00169	06141	663	17	2	
	DIODE	088-10-09360	JEDEC	1N936	6	1	
	RELAY	219-98-00010	95073	24MM-1C	7	2	
	RELAY	219-98-00011	95073	24MM-1A	18	3	
	RELAY	219-98-00012	95073	24MM-2A	50	6	
	RELAY	219-98-00013	95073	24MM-3A	26	3	
	RELAY	219-98-00014	95073	24MM-1B	2	1	
	RESISTOR, 10 ohm, 5%, 1/4W	616-02-01009	01121	RC07GF100J	16	2	
	RESISTOR, 47 ohm, 5%, 1/4W	616-02-04709	01121	RC07GF470J	17	2	

Price and delivery of recommended spares on request.

Table 6-2 (Cont'd.). List of Model 2721 Multi-Used Parts and Recommended Spares

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	RESISTOR, 100 ohm, 5%, 1/4W	616-02-10002	01121	RC07GF101J	18	2	Price and delivery of recommended spares on request.
	RESISTOR, 120 ohm, 5%, 1/4W	616-02-12009	01121	RC07GF121J	3	1	
	RESISTOR, 150 ohm, 5%, 1/4W	616-02-15009	01121	RC07GF151J	3	1	
	RESISTOR, 330 ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	4	1	
	RESISTOR, 470 ohm, 5%, 1/4W	616-02-47009	01121	RC07GF471J	5	1	
	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	63	6	
	RESISTOR, 1.1K, 5%, 1/4W	616-02-11000	01121	RC07GF112J	30	3	
	RESISTOR, 1.2K, 5%, 1/4W	616-02-12000	01121	RC07GF122J	9	1	
	RESISTOR, 1.6K, 5%, 1/4W	616-02-16000	01121	RC07GF162J	3	1	
	RESISTOR, 1.8K, 5%, 1/4W	616-02-18000	01121	RC07GF182J	4	1	
	RESISTOR, 2K, 5%, 1/4W	616-02-20000	01121	RC07GF202J	5	1	
	RESISTOR, 2.2K, 5%, 1/4W	616-02-22000	01121	RC07GF222J	13	2	
	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	9	1	
	RESISTOR, 3K, 5%, 1/4W	616-02-30000	01121	RC07GF302J	21	2	
	RESISTOR, 3.3K,5%, 1/4W	616-02-33000	01121	RC07GF332J	25	3	
	RESISTOR, 3.6K, 5%, 1/4W	616-02-36000	01121	RC07GF362J	3	1	
	RESISTOR, 3.9K, 5%, 1/4W	616-02-39000	01121	RC07GF392J	8	1	
	RESISTOR, 4.7K, 5%, 1/4W	616-02-47000	01121	RC07GF472J	45	5	
	RESISTOR, 5.1K, 5%, 1/4W	616-02-51000	01121	RC07GF512J	7	1	
	RESISTOR, 7.5K, 5%, 1/4W	616-02-75000	01121	RC07GF752J	7	1	
	RESISTOR, 8.2K, 5%, 1/4W	616-02-82000	01121	RC07GF822J	3	1	
	RESISTOR, 9.1K, 5%, 1/4W	616-02-91000	01121	RC07GF912J	9	1	
	RESISTOR, 10K, 5%, 1/4W	616-02-10001	01121	RC07GF103J	30	3	
	RESISTOR, 11K, 5%, 1/4W	616-02-11001	01121	RC07GF113J	6	1	
	RESISTOR, 16K, 5%, 1/4W	616-02-16001	01121	RC07GF163J	3	1	
	RESISTOR, 22K, 5%, 1/4W	616-02-22001	01121	RC07GF223J	2	1	
	RESISTOR, 24K, 5%, 1/4W	616-02-24001	01121	RC07GF243J	8	1	
	RESISTOR, 27K, 5%, 1/4W	616-02-27001	01121	RC07GF273J	4	1	
	RESISTOR, 47K, 5%, 1/4W	616-02-47001	01121	RC07GF473J	18	2	
	RESISTOR, 51K, 5%, 1/4W	616-02-51001	01121	RC07GF513J	4	1	
	RESISTOR, 91K, 5%, 1/4W	616-02-91001	01121	RC07GF913J	5	1	
	RESISTOR, 100K, 5%, 1/4W	616-02-10002	01121	RC07GF104J	14	1	
	RESISTOR, 12K, 5%, 1/4W	616-02-12001	01121	RC07GF123J	9	1	

Table 6-2 (Cont'd.). List of Model 2721 Multi-Used Parts and Recommended Spares

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	RESISTOR, 1M, 5%, 1/4W	616-02-10003	01121	RC07GF105J	15	2	Price and delivery of recommended spares on request.
	RESISTOR, 680 ohm, 5%, 1/4W	616-02-68009	01121	RC07GF681J	2	1	
	RESISTOR, 270 ohm, 5%, 1/4W	616-02-27009	01121	RC07GF271J	2	1	
	RESISTOR, 330 ohm, 5%, 1/4W	616-02-33009	01121	RC07GF331J	3	1	
	RESISTOR, 1K, 5%, 1/4W	616-02-10000	01121	RC07GF102J	2	1	
	RESISTOR, 2.4K, 5%, 1/4W	616-02-24000	01121	RC07GF242J	2	1	
	RESISTOR, 470 ohm, 10%, 2W	624-03-47009	01121	RC42GF471K	3	1	
	RESISTOR, 3.16K, 1%, 1/8W	605-09-31600	06141	625	2	1	
	RESISTOR, 3.32K, 1%, 1/8W	605-09-33200	06141	625	9	1	
	RESISTOR, 4.64K, 1%, 1/8W	605-09-46400	06141	625	4	1	
	RESISTOR, 4.99K, 1%, 1/8W	605-09-49900	06141	625	4	1	
	RESISTOR, 5.62K, 1%, 1/8W	605-09-56200	06141	625	2	1	
	RESISTOR, 6.19K, 1%, 1/8W	605-09-61900	06141	625	2	1	
	RESISTOR, 10K, 1%, 1/8W	605-09-10001	06141	625	5	1	
	RESISTOR, 12.4K, 1%, 1/8W	605-09-12401	06141	625	2	1	
	RESISTOR, 20.5K, 1%, 1/8W	605-09-20501	06141	625	3	1	
	RESISTOR, 24.9K, 1%, 1/8W	605-09-24901	06141	625	2	1	
	RESISTOR, 49.9K, 1%, 1/8W	605-09-49901	06141	625	6	1	
	RESISTOR, 100K, 1%, 1/8W	605-09-10002	06141	625	4	1	
	RESISTOR, 200K, 1%, 1/8W	605-09-20002	06141	625	4	1	
	RESISTOR, 402K, 1%, 1/8W	605-09-40202	06141	625	4	1	
	POTENTIOMETER, 200 ohm, 20%, 1/3W	201-98-00047	01121	NX201M	9	1	
	POTENTIOMETER, 500 ohm, 20%, 1/3W	201-98-00048	01121	NX501M	2	1	
	POTENTIOMETER, 500 ohm, 10%, 1/3W	201-98-00014	01121	2600P-501-BS1066	3	1	
	POTENTIOMETER, 1K, 10%, 1W	201-98-00015	01121	2600P-201-BS1066	2	1	
	TRANSISTOR	263-16-00059	04713	MM2484	5	1	
	TRANSISTOR	263-10-30540	JEDEC	2N3054	3	1	
	TRANSISTOR	263-10-35650	JEDEC	2N3565	47	5	
	TRANSISTOR	263-10-35660	JEDEC	2N3566	29	3	
	TRANSISTOR	263-10-36380	JEDEC	2N3638	10	1	

Table 6-2 (Cont'd.). List of Model 2721 Multi-Used Parts and Recommended Spares

REF. DESIG.	DESCRIPTION	EMR STOCK NO.	MFGR. CODE	MFGR. PART NO.	TQ	RS	UNIT PRICE
	TRANSISTOR	263-10-36380	JEDEC	2N3638	5	1	
	TRANSISTOR	263-10-39040	JEDEC	2N3904	29	3	
	TRANSISTOR	263-10-39060	JEDEC	2N3906	28	3	
	INTEGRATED CIRCUIT	046-16-00008	04713	MC351G	7	1	
	INTEGRATED CIRCUIT	046-16-00004	04713	MC352G	11	1	
	INTEGRATED CIRCUIT	046-16-00005	04713	MC354G	14	1	
	INTEGRATED CIRCUIT	046-16-00001	04713	MC356G	28	3	
	INTEGRATED CIRCUIT	046-16-00002	04713	MC358G	50	6	
	INTEGRATED CIRCUIT	046-16-00003	04713	MC360G	72	7	
	INTEGRATED CIRCUIT	046-16-00009	04713	MC367G	7	1	
	INTEGRATED CIRCUIT	046-14-00017	93332	SG-42-03	3	1	
	INTEGRATED CIRCUIT	046-14-00010	93332	SG-133-03	14	1	
	INTEGRATED CIRCUIT	046-14-00006	93332	SM-73-03	10	1	
	INTEGRATED CIRCUIT	046-18-00001	07263	U5B771039X	5	1	
	INTEGRATED CIRCUIT	046-18-00006	07263	U5B771239X	3	1	

Price and delivery of recommended spares on request.

MANUFACTURERS' NAMES AND CODE NUMBERS

MFR'S CODE	MFR'S NAME AND ADDRESS
00779	Amp, Inc., Harrisburg, Pa.
01121	Allen-Bradley Co., Milwaukee, Wis.
01686	RCL Electronics, Inc., Manchester, N. H.
02111	Spectrol Electronics Corp., City of Industry, Calif.
02660	Amphenol Corp., Broadview, Ill.
02735	Radio Corp. of America, (RCA) Somerville, N. J.
03797	Eldema Corp., Compton, Calif.
04713	Motorola Semiconductor Products, Inc., Phoenix, Ariz.
05170	Engineered Electronics Co., Inc. Santa Ana, Calif.
06141	Electro-Mechanical Research, Inc., Sarasota, Fla.
06184	Conelco Components, San Bernardino, Calif.
06540	Amathom Electronic Hdwr. Co., Inc., New Rochelle, N. Y.
07137	Transistor Electronics Corp., Minneapolis, Minn.
07263	Fairchild Camera and Instrument Corp., Mountain View, Calif.
07716	IRC, Inc., Burlington, Iowa
09353	C and K Components, Inc., Newton, Mass.
09922	Burndy Corp., Norwalk, Conn.
12697	Clarostat Mfg. Co., Inc., Dover, N. H.
13511	Amphenol Corp., Los Gatos, Calif.
14655	Cornell-Dubilier Electric Corp., Newark, N. J.
14752	Electro Cube, Inc., Pasadena, Calif.
17276	Nexus Research Lab, Dedham, Mass.
22229	Union Carbide, Mountain View, Calif.

MANUFACTURERS' NAMES AND CODE NUMBERS

MFR'S CODE	MFR'S NAME AND ADDRESS
25244	Centralab Div. Globe-Union, Milwaukee, Wis.
56289	Sprague Electric Co., North Adams, Mass.
71450	CTS Corp., Elkhart, Ind.
71468	Cannon Electric Co., Los Angeles, Calif.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg. Co., Chicago, Ill.
73705	Electronic Products Inc., Cleveland, Ohio
74545	Harvey Hubbel, Inc., Bridgeport, Conn.
74970	E. F. Johnson Co., Waseca, Minn.
75915	Littelfuse, Inc., Des Plaines, Ill.
80294	Bourns, Inc., Riverside, Calif.
78769	E. H. Titchener and Co., Binghamton, N. Y.
G81349	Military Specifications Promulgated by Standardization Div. Directorate of Logistic Services DSA
81590	Korry Mfg. Co., Seattle, Wash.
83594	Burroughs Corp., Plainfield, N. J.
90201	Mallory Capacitor Co., Indianapolis, Ind.
91506	Augat, Inc., Attleboro, Mass.
91737	Gremar Mfg. Co., Inc., Wakefield, Mass.
93332	Sylvania Electric Prod., Inc., Semiconductor Div., Woburn, Mass
94412	Dressen Barnes Electronic Corp., Pasadena, Calif.
95073	Douglas Randall, Inc., Westerly, R.I.
95275	Vitramon, Inc., Bridgeport, Conn.

MANUFACTURERS' NAMES AND CODE NUMBERS

MFR'S CODE	MFR'S NAME AND ADDRESS
95692	Artisan Electronics Corp., Parisppany, N. J.
97564	Clare-Pendar, Inc., Post Falls, Idaho
98291	Sealectro Corp., Mamaroneck, N. Y.

Table 6-3. Customer Provisioning Questionnaire

1.	Equipment to be spared Model No.(s): _____ Serial No.(s): _____
2.	Number of equipments to be spared in each location _____
3.	Operating time and cycle: _____ hours/day, _____ days/ week.
4.	Operating Environment: A. Temperature: _____ B. Humidity: _____ C. Altitude: _____ D. Shock and Vibration: _____
5.	Non-operating Environment: _____ A. Temperature: _____ B. Humidity: _____ C. Altitude: _____
6.	Desired probability of being able to spare from complement _____ percent for _____ months.
7.	Can usage permit troubleshooting to parts level when a failure occurs? _____
8.	What spare assemblies do you have that are used in this Model Equipment? _____
9.	Do you wish us to exclude the EMR warranty period? _____